

Water for Fodder Review – Final Report

A report for the Department of Agriculture, Water and Environment

29 April 2020

A Marsden Jacob Report

Prepared for Department of Agriculture, Water and Environment
Marsden Jacob Associates

ABN 66 663 324 657
ACN 072 233 204

e. economists@marsdenjacob.com.au
t. 03 8808 7400

Office locations

Melbourne
Perth
Sydney
Newcastle
Brisbane

Authors

Stuart Maclachlan	Marsden Jacob Associates
Simo Tervonen	Marsden Jacob Associates
David Rogers	Marsden Jacob Associates
Rod Carr	Marsden Jacob Associates

LinkedIn - Marsden Jacob Associates
www.marsdenjacob.com.au

Acknowledgements

Marsden Jacob would like to acknowledge and thank all the people who commented on the report. The report is better for your input. All final recommendations and views in this report are attributable to Marsden Jacob unless otherwise stated.

Statement of Confidentiality

The contents of this report and any attachments are confidential and are intended solely for the addressee. The information may also be legally privileged. If you have received this report in error, any use, reproduction or dissemination is strictly prohibited. If you are not the intended recipient, please immediately notify the sender by reply e-mail or phone and delete this report and its attachments, if any.

Disclaimer

This document has been prepared in accordance with the scope of services described in the contract or agreement between Marsden Jacob Associates Pty Ltd ACN 072 233 204 (Marsden Jacob) and the Client. This document is supplied in good faith and reflects the knowledge, expertise and experience of the advisors involved. The document and findings are subject to assumptions and limitations referred to within the document. Any findings, conclusions or recommendations only apply to the aforementioned circumstances and no greater reliance should be assumed or drawn by the Client. Marsden Jacob accepts no responsibility whatsoever for any loss occasioned by any person acting or refraining from action because of reliance on the document. The document has been prepared solely for use by the Client and Marsden Jacob Associates accepts no responsibility for its use by other parties.

Contents

Executive Summary	5
1. Introduction	8
1.1 Project Scope and Background	8
1.2 Summary Methodology	9
2. Hydrological Considerations	12
2.1 Key Findings	13
2.2 South Australian Water Sources	13
2.3 Metropolitan Adelaide Water Supply	15
2.4 2020/21 Water Balance Scenarios	20
2.5 River Murray Storage Outlook	21
3. Water Market Allocation and Price Considerations	24
3.1 Key Findings	24
3.2 Southern Murray-Darling Basin Allocation Outlook	24
3.3 Projected Market Prices	29
4. Commodity Considerations	32
4.1 Key Findings	32
4.2 Commodity Demand	32
4.3 Commodity Margin Analysis	33
4.4 Commodity Outlook and Demand	35
Appendix 1 – Water availability scenarios	37
Tables	
Table 1: Terms of reference	8
Table 2: Climate Outlooks and relative Probability of Exceedance (POE)	10
Table 3: South Australian Water Balance	20
Table 4: NSW Murray and Murrumbidgee general security allocation outlooks for 2020–21	25
Table 5: Victorian Murray and Goulburn high reliability allocation outlooks for 2020–21	25
Table 6: SA Murray class 3 allocation outlook for 2020–21	26
Table 7: ABARES water allocation price scenarios for 2020–21	30
Table 8: Range of annual water demands for selected crops in the southern Basin	33
Table 9: Indicative margin returns for selected crop types in the southern Basin	34
Table 10: Range of potential annual water demands (GL), based on area watered in 2018 and historical application rates (ML/ha)	36
Table 11: Marsden Jacob outlook scenarios matched against state outlook scenarios and assumptions used	37

Figures

Figure 1: MDBA Water Sharing Arrangements	12
Figure 2: SA Water Allocation Frameworks	14
Figure 3: WMLR storage volume since June 2009	16
Figure 4: 2020/21 SA Entitlement Flow Availability	16
Figure 5: River Murray Monthly Inflow Comparison	17
Figure 6: Adelaide metropolitan urban supply region	19
Figure 7: MDBA Active Storage: June to Present	22
Figure 8: River Murray storage (Hume and Dartmouth) projections	23
Figure 9: Forecast available water (allocation + estimated carryover minus environmental holdings) for southern Basin in 2020/21	27
Figure 10: Forecast available water (allocation + estimated carryover minus environmental holdings) for Murray below Choke areas only in 2020/21	28
Figure 11: Southern Basin annual VWAP price vs. available water 2007-2020	29
Figure 12: Projected southern Basin annual VWAP allocation prices for 2020/21 under various inflow scenarios with upper and lower bound estimates	30

Acronyms and Abbreviations

ACCC	Australian Competition and Consumer Commission
ADP	Adelaide Desalination Plant
CHWN	Critical Human Water Needs
CP	Consumptive Pool
DAWE	Australian Government Department of Agriculture, Water and Environment
DEW	South Australian Department for Environment and Water
DPIE	NSW Department of Planning, Industry and Environment
GL	Gigalitre
MDBA	Murray Darling Authority
ML	Megalitre
NSW	New South Wales
NVRM	Northern Victoria Resource Manager
SA	South Australia
WMLR	Western Mount Lofty Ranges

Executive Summary

The Australian Government Water for Fodder program aims to provide subsidised water for farmers to grow fodder during a time of widespread drought across the Murray-Darling Basin (the Basin)¹. The water provided for this program was enabled through the use of the Adelaide Desalination Plant (ADP) to substitute for water allocated to the Metropolitan Adelaide licence, which is used to supply a range of water users including critical human water needs (CHWN).

To inform decision-making on Round 2 of the program, the Australian Government Department of Agriculture, Water and the Environment has engaged Marsden Jacob to review the ability of South Australia to again use the ADP to substitute for water from their River Murray allocation without impacting on the provision of CHWN and overall water security, and provide insight into commodities across the southern Basin based on supply and demand factors.

Within this analysis we have considered hydrological, water market and commodity factors along with the views of industry experts to ensure our assumptions and methodology product are accurate and results are robust.

The overall key findings across this report are summarised below.

Key finding #1: ADP production will be required in 2020/21, although it is constrained by operational considerations and water availability in both the River Murray and Western Mount Lofty Ranges (WMLR)

The ADP will be required to operate in 2020/21, however at this time it is not possible to determine if this will be to supply water for Metropolitan Adelaide and or for the Water for Fodder program.

While the ADP has a theoretical maximum annual production of 100 GL per year (rated at 300 ML/day), the scenario analysis reveals that in practice the maximum ADP production ranges from 77 GL in Very Dry to 34 GL under Wet conditions. ADP production is constrained by operational limitations, customer demand and water availability in the River Murray and Mount Lofty Ranges.

Key finding #2. At this time, South Australia does not have sufficient water security based on the current low water availability in the Mount Lofty Ranges and Murray-Darling Basin to permit Round 2 of the Water for Fodder program

The water supply situation for South Australia will develop over the water year. It will not be until after winter and spring inflows, that actual water availability for the 2020/21 water year begin to emerge. At this point, South Australia will have a better understanding of its ability to deliver upon Round 2 of the Water for Fodder program.

¹ [BOM climate update](#)

Key finding #3: Only under specific water availability conditions could the ADP be used to substitute River Murray water

It is only under specific climatic circumstances that the ADP might maximise production. Based on input from the South Australian Government we understand that if 2020/21 aligns with the Dry climate outlook, then the ADP could maximise its production capacity to produce an additional 60 GL for the Water for Fodder program without impacting on South Australia's water security. Under Average and Wet outlooks a lower Round 2 volume could be provided. Whereas, under very dry conditions in both the River Murray and Mount Lofty Ranges the vast majority of the ADP production is expected to be needed to supply Metropolitan Adelaide and thus to ensure that ability to meet demand is not compromised for 2021/22.

Critically, volume and timing of when this water would become available is difficult to predict because it will not be known until early in the second quarter as to which water availability outlook is occurring. Fortunately, the Water for Fodder agreements allowed for the provision of the 60 GL over 2020/21, and the balance over 2021/22 if required.

Key finding #4: Significant rainfall is required to improve storage levels above 2019/20

While the BOM climate outlook indicates improvement in rainfall relative to those projected at the end of 2019, several months of above average rainfall in the catchments that flow into the MDBA controlled storages would be required to improve water storages so that they would be above 2019/20.

We estimate that water supply for consumption in 2020/21 is expected to increase significantly in the average scenario to 4,921GL, reflecting an increase in forecast allocations (from state water agencies) from the very low levels experienced in 2019/20².

Key finding #5: Allocations are expected to start low

Indicative opening allocations across the three Basin States on the River Murray have been released. Low opening allocations are projected for VIC high reliability, SA Class 3 (high security) and NSW general security. NSW high security is expected to open with 97% to 95% allocation depending on the zone. Unless there is significant rainfall between now and the start of the 2020/21 water year this situation will not change.

The announced allocation is expected to increase across the season, with allocations e.g. predicted to reach 100% for VIC high reliability and 92% for SA Murray high security under 'average' seasonal conditions. However, the progression of announced allocations will not be known until we are several months into the water year.

² This is in line with the ABARES estimate of 4,774 GL under average scenario. Full details here: [ABARES Water market outlook – March 2020](#)

Key finding #6: Water market prices likely to remain high if low water availability continues into 2020/21

Based on Marsden Jacob's market analysis, the average annual price ranges in the southern Basin under different inflow scenarios are as follows:

- Extreme dry: \$800 - 1,000 per ML
- Dry: \$600 - 800 per ML
- Average: \$120 - 250 per ML
- Wet: \$70 - 120 per ML

Allocating this water to fodder production thus comes as a potential opportunity cost to other crop types with higher margin returns and more to lose in times of low water availability, most particularly perennial crops that cannot significantly scale down their water use, rather they may require more water if crops are continuing to mature. Whereas fodder and other annual crop producers tend to have greater flexibility in terms of their operational scale.

Key finding #7: The projected demand and consequences for different irrigated commodities will be driven by water availability and capacity to pay for water

Low water allocation leading to shortfalls in water supply are likely to result in reduced areas planted to annual crops, such as cotton, rice, and wheat. Demand for water to irrigate permanent crops (e.g. almonds, wine grapes) is much less responsive to water availability and market prices, because crop water supply cannot be significantly reduced without potentially affecting future plant viability. While perennial crop growers do not want to spend more for their water, fortunately they do typically have higher capacity to pay for water (see Table 9). This higher capacity to pay means irrigators of permanent crops are likely to outcompete irrigators of annual crops for the water that is available on the market.

Key finding #8: Commodities with a higher capacity to pay for water have more opportunity to purchase water and remain sustainable

Although current temporary water prices are softening as a result of recent rainfall, with some growers purchasing water in April from the spot market for carryover purposes, under dry and extreme dry scenarios, there is expected to be less water available. Those irrigators who have higher capacity to pay can afford to enter the spot market, while those commodities with lower capacity to pay will be at a higher risk of being able to gain water at a reasonable cost and ensure continued sustainability.

1. Introduction

1.1 Project Scope and Background

1.1.1 Water for Fodder Overview

The Australian Government has reached an agreement with South Australia to produce up to 100 GL of water over two years from the Adelaide Desalination Plant (ADP) at the actual marginal cost of production; and to transfer water allocations from entitlements held by South Australia to irrigators in the southern Basin under its Water for Fodder program. The Water for Fodder program forms part of the Australian Government's drought response package to improve the resilience of farmers and rural communities during this current drought.

1.1.2 Project Scope

A key component of the agreement reached between the Australian and South Australian Governments was that a gateway review of Round 1 (40 GL) of the Water for Fodder program would be undertaken to inform whether Round 2 (60 GL) was able to proceed, either as intended or in a modified form.

The Australian Government Department of Agriculture, Water and the Environment has engaged Marsden Jacob Associates (Marsden Jacob) to help inform decision making on Round 2 of the program by advising on matters related to water availability and the risk exposure of water dependent agricultural sectors across the Basin.

Table 1 summarises the terms of reference and links them to the key findings.

Table 1: Terms of reference

3.a. Water availability		
Does South Australia have sufficient water security to enable Round two to proceed as intended?		Key finding #1, #2 and #3
If not, does South Australia have sufficient water security to enable Round two to proceed with a volume lower than 60 GL, or to split the delivery of the 60 GL over the 2020/21 and 2021/22 water years?		
What are the current and projected storage levels across the Murray-Darling Basin in 2019/20 and 2020/21?		Key finding #4
What are the current and projected future water allocations across the Murray-Darling Basin in 2019/20 and 2020/21?		Key finding #5
What are the current and projected future water prices across the Murray-Darling Basin in 2019/20 and 2020/21?		Key finding #6
Will South Australia's water security be compromised if an additional 60 GL from metropolitan Adelaide's River Murray Water Allocation is traded onto the market across the 2020/21 water year?		Key finding #3

Does projected unmet demand for water for major irrigated commodity sectors in the Southern Murray-Darling Basin during the 2020/21 water year present a risk to the ability of fodder-reliant sectors to gain water at a reasonable cost in order to produce fodder?	Key finding #8
3.b. Risk exposure of water-dependent agricultural sectors across the Basin	
What is the projected demand for product in each major irrigated commodity sector in the Southern Murray-Darling Basin during the 2020/21 water year?	Key finding #7
What is the consequence for each major irrigated commodity sector in the Southern Murray-Darling Basin of there being insufficient water during the 2020/21 water year?	Key finding #7
What sectors are at greatest risk (in terms of continued sustainability) due to there being insufficient water during the 2020/21 water year?	Key finding #8

1.2 Summary Methodology

1.2.1 Hydrological Considerations Analysis

Based on the information gathered for this project, a high-level water balance was developed that tests South Australia's ability to supply water for the Water for Fodder program. We further utilise current storage, projected and historical inflows, and water availability scenarios to assess potential storage levels across the Southern Basin over the next water year.

Overall assumptions that are relevant to the analysis:

- Basin State water sharing arrangements do not change in relation to South Australia's access to deferred storage volumes in Hume and Dartmouth dam.
- The actual production capacity of the ADP is up to 77 GL/year³⁴.
- South Australia may access deferred water to supply to CHWN. Whilst this volume may underpin the full CHWN requirements at the start of the year, South Australia has advised that restricting the use of South Australia's deferred CHWN in 2020/21 to a maximum of 108 GL is critical, if possible. To ensure a minimum level of water security for 2021/22, at least 131 GL is required in storage at the end of 2020/21.

The water balance considers the following supply and demand inputs:

- Demand and water availability from South Australia's River Murray Entitlement
- Demand for water deferred under South Australia River Murray storage right
- Production capabilities of the Adelaide Desalination Plant
- Demand for water from the Adelaide metropolitan region
- Western Mount Lofty Range storage inflows are considered across four climatic scenarios with

³ Advice from SA Water and Department for Environment and Water

⁴ The theoretical capacity of the ADP is 100 GL per year.

a probability of exceedance (POE) ranging from Very Dry (90%), Dry (70%), Average (50%) and Wet (40%). Although the water balance is centred around WMLR likelihood, it is important context to highlight the similarities and differences between WMLR and River Murray climatic outlooks (Table 2).

Table 2: Climate Outlooks and relative Probability of Exceedance (POE)

Climatic Outlook	River Murray POE	WMLR POE
Very Dry	90%	90%
Dry	75%	70%
Average	50%	50%
Wet	25%	40%

Source: South Australian Department for Environment and Water

1.2.2 Market Considerations Analysis

Accurately projecting market prices, even one or two years ahead, is very difficult and involves wide confidence bounds. Water markets have undergone a number of structural shifts that cannot be captured in the historical data, and that affects the robustness of price predictions from longer term market prediction models (econometric models). So, instead of relying on econometric modelling to estimate the projected water allocation prices, we used the following method:

- We performed statistical modelling that focused on a number of key market price drivers, including:
 - water availability (e.g. inflows to storages and announced allocations)
 - the size of the consumptive pool
 - market performance during previous drought (millennium and more recent) and wet periods
 - commodity market and production trends.
- We interviewed a number of market intermediaries from across the Basin to test the current market drivers and price outlooks for different entitlement types.
- We reviewed historical broker interviews—Marsden Jacob has been interviewing brokers since early 2011 and has a running log of the results from those interviews.
- We drew upon and updated our net margin models for key crop types. The models can be used to estimate price ceilings based on capacity to pay for key irrigated crops

The key sources of data for the market considerations analysis in this project included:

- [BoM Water Information Dashboard](#)
- [New South Wales Water Register](#)
- [Victorian Water Register](#)
- [South Australia WaterConnect](#)
- Water market intermediary bulletin boards and exchanges.
- Marsden Jacob: Waterflow™ information platform.

1.2.3 Commodity Consideration Analysis

To inform the commodity analysis, the scope of products is limited to perennial tree crops, wine grapes, rice, cotton, and fodder (lucerne and wheat), as there is sufficient data available for these production systems. The analysis provides indicative estimates of margin returns, and capacity to pay for water, for selected crop types in the Southern Basin. Due to time, budget and availability of margin estimates we have only considered a key set of crops, as agreed with the client at project initiation.

The margin analysis undertaken relies on gross margin budgets from a range of sources, which have been modified by updating input prices in the original budgets to reflect current prices, and adjusting irrigation requirements to reflect differences between local growing conditions and those used in the original budgets.

A range of estimates, rather than a point estimate, are provided to account for published gross margin budgets (e.g. NSW DPIE, AgMargins) being based on average or representative farms. In practice, some farms will outperform, and others will underperform, relative to average farms. Also, it is unlikely that the upper bound would have been achieved by the majority of producers. Therefore, a more conservative approach is used because the average impact of lower water availability means producers would likely be nearer the lower bound, in the absence of other evidence.

1.2.4 Consultation Process

To inform the development of the report, semi-structured interviews with industry associations, market intermediaries and stakeholders were undertaken. We have also drawn upon information available from previous engagements with water market intermediaries and market participants.

2. Hydrological Considerations

The most well-known and agriculturally productive region in Australia is the Murray-Darling Basin. It is responsible for most of Australia's irrigated agricultural production and covers the Australian Capital Territory and parts of Queensland, New South Wales, Victoria and South Australia.

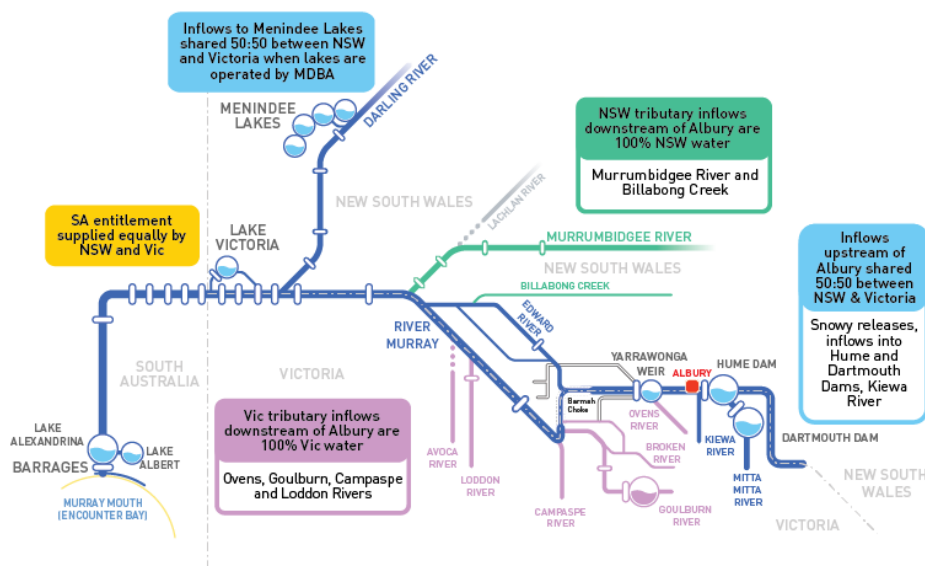
The River Murray located in the southern Basin, provides water for New South Wales, Victoria and South Australia. Water sharing arrangements for the River Murray have been in place since 1914, with the introduction of the River Murray Waters Agreement between the Australian Government and these three States. Water sharing arrangements have fundamentally remained the same, with only incremental changes over time.

The general principle of water sharing for the River Murray system is that New South Wales and Victoria each receive 50% of the flow upstream of Albury (i.e. inflows to Hume, Dartmouth and from the Kiewa River) and 50% of inflows to Menindee Lakes (Figure 1).

From state shares held in storage and tributary inflows assigned to each state of origin, New South Wales and Victoria provide South Australia with its Entitlement, which varies from month to month as stipulated in the *Murray–Darling Basin Agreement* (the Agreement). In dry years, South Australia essentially receives a third share of the water available in the River Murray system.

In 2011, approval was given for South Australia to store part of its Entitlement in the major storages for the purposes of meeting its critical human water needs and private carryover.

Figure 1: MDBA Water Sharing Arrangements



Source: MDBA⁵

⁵ Murray-Darling Basin Authority - [Water Sharing in the River Murray](#)

2.1 Key Findings

The key findings of this analysis are as follows:

1. ADP production is constrained by operational and climatic considerations. The maximum ADP production is 77 GL and the minimum is 34 GL.
2. South Australia does not have sufficient water security to enable Round 2 of the Water for Fodder program to proceed as planned at this time. However, as the water year progresses and water availability changes, circumstances may become apparent that enable the Water for Fodder program to run either in full or split across water years.
3. It is only under specific climatic circumstances that the ADP might maximise production. If 2020/21 is emerging as a Dry climate outlook, then the ADP could maximise its production capacity to produce an additional 60 GL for the Water for Fodder program without impacting on South Australia's water security.
4. Except for a Very Dry climate outlook, it is possible that a lower Round 2 volume could be provided, but the volume and timing of when this water would become available is difficult to predict and will not be known until later in the water year which climate outlook is occurring.

2.2 South Australian Water Sources

2.2.1 River Murray

The River Murray in South Australia sits at the end of the Murray-Darling Basin system and is the state's largest reliable surface water resource. The River Murray is essential to supporting internationally significant ecosystems, nationally important economies, culture, and way of life. South Australia diverts around 7 percent of the Basin's extracted surface water resources.⁶

Prior to the ADP being completed SA Water provided metropolitan Adelaide's water needs from a range of sources, with the key sources being the River Murray and the WMLR.

The ADP was completed in 2012, increasing South Australia's water security as it provides another source of water for metropolitan Adelaide and reduces the impacts of low water availability in the River Murray and the WMLR storages.

Under the Murray–Darling Basin Agreement, South Australia receives an 'Entitlement' from the River Murray of up to 1,850 gigalitres (GL) per year (Figure 2). This can be considerably lower in dry years, for example during the height of the millennium drought, the water made available for South Australia in 2007/08 and 2008/09 were 860 GL and 918 GL, respectively⁷.

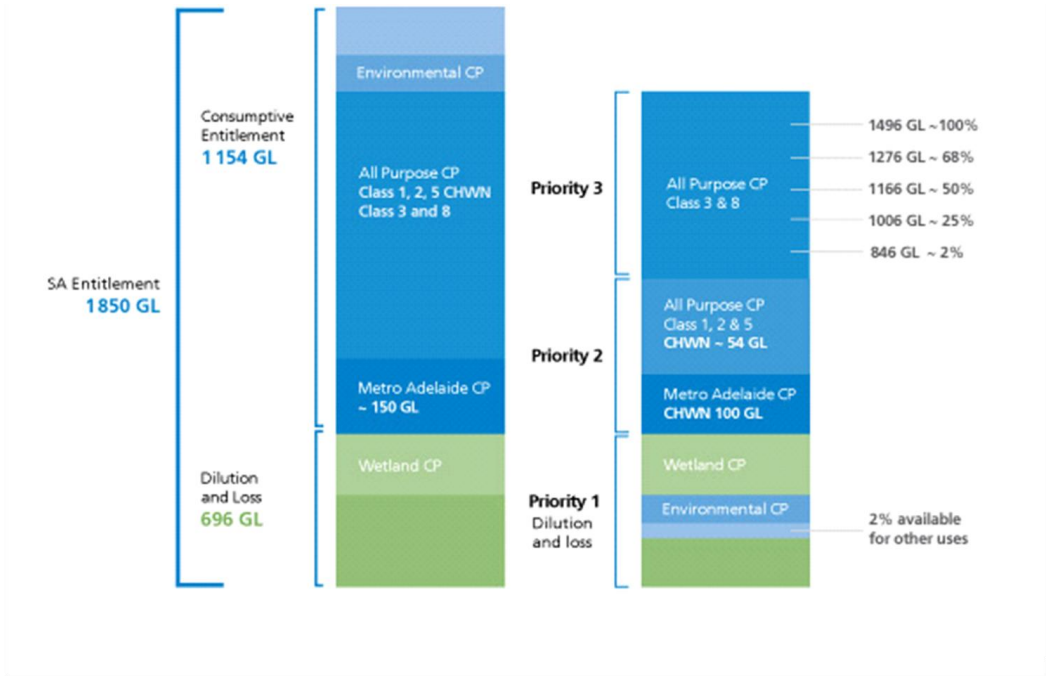
The Consumptive Entitlement (up to 1,154 GL per year) is the maximum volume for non-dilution and loss purposes provided to South Australia in any year. This component provides allocations for consumptive purposes (e.g. critical human water needs, irrigation and industry) and against held environmental entitlements. A small volume remains unallocated.

⁶ Water Allocation Plan for The River Murray Prescribed Watercourse 2019

⁷ MDBA

The Dilution and Loss Entitlement (696 GL per year) provides for conveyance losses from the SA border down the River Murray, whilst the dilution component ensures that water of suitable quality for human consumption can be extracted at the end of the River Murray before it flows into Lake Alexandrina.

Figure 2: SA Water Allocation Frameworks



Source: South Australian River Murray Water Allocation Plan⁸

2.2.2 Critical Human Water Needs (CHWN)

The *Water Act 2007*, *Murray-Darling Basin Plan 2012* (Basin Plan) and *Murray-Darling Basin Agreement 2008* include obligations around CHWN, recognising the importance of having explicit arrangements in place for low water availability conditions. CHWN are considered the highest priority water use, and water sharing arrangements between Basin states ensure that conveyance water is set aside to deliver CHWN.

The Basin Plan sets out the volumes required to meet the CHWN for the communities that are dependent on the waters of the River Murray system, however each state is responsible for meeting its own needs. The stated volume for South Australia’s CHWN is 204 GL. This figure comprises 150 GL for metropolitan Adelaide, which factors in the volumes available and required during periods of very low water availability in both the River Murray system and the WMLR. It also includes 34GL for Country Towns (Class 2) and 20 GL for stock and domestic users (Class 1), Industrial and dairy (Class 5) users and unlicensed stock and domestic users (statutory rights).

Following the millennium drought, changes to water sharing arrangements have been introduced that provide greater water security to CHWN. For South Australia, new storage rights are now

⁸ [South Australian River Murray water resource plan 2019](#)

available to increase the likelihood that CHWN can be met in dry times, as well as allowing storage for private carryover purposes, without affecting the reliability of upstream entitlement holders.

South Australia's storage rights are reflected in clause 91, clause 130 and Schedule G of the Agreement. The Agreement provides South Australia with the right to store (defer) part of its Entitlement in the upstream major storages and subsequently deliver it for CHWN and private carryover in a future year. South Australia has indicated that the volume deferred for CHWN by South Australia in upstream storages should be maintained at a minimum of 131 GL⁹. This is to ensure that future CHWN requirements can be met in proceeding water years (2021/22).

The actual volume of CHWN allocated against the Metropolitan Adelaide licence is determined by the South Australian Water Minister in accordance with the River Murray Water Allocation Plan. It varies depending on the overall Entitlement provided to SA under the Murray-Darling Basin Agreement (Figure 2) as well the volume available in South Australia's Storage Right.

When the combined volume of the Consumptive Entitlement and Dilution and Loss Entitlement is less than 1,496 GL, the volume allocated for Metropolitan Adelaide's CHWN from the current year's Entitlement is up to 100 GL. Once this increases to 1,546 GL, the volume allocated to CHWN increases to 150 GL.

Therefore, Metropolitan Adelaide's extractions will be restricted during years in which Consumptive Entitlements do not reach 100 per cent. In these years, South Australia has advised that the total annual volume diverted for metropolitan Adelaide will not exceed 150 GL, which is the volume required to meet critical human water needs in metropolitan Adelaide.

As of February 2020, there is currently 241 GL deferred for CHWN under South Australia's deferred storage right in Dartmouth dam¹⁰. Taking into account the above minimum set, this means that at this time no more than 108 GL can be used in 2020/21 without impacting South Australia's water security for 2021/22.

2.3 Metropolitan Adelaide Water Supply

Adelaide and other towns connected to the SA Water supply network can access water from a number of sources to meet annual urban needs. Those sources primarily include the following:

- Reservoirs located in the WMLR
- South Australia's River Murray entitlement and subsequent diverted water; and
- water available from the ADP

2.3.1 Western Mount Lofty Ranges

The WMLR are the preferred source of water from a cost per megalitre perspective. At full capacity, SA Water's WMLR reservoirs can hold almost 200 GL of water. Water availability from this source is highly variable, falling to less than 40 GL, with a 10-year average of 115 GL /year. For this project, South Australia has provided modelled WMLR inflows that range from 46 GL under Very Dry

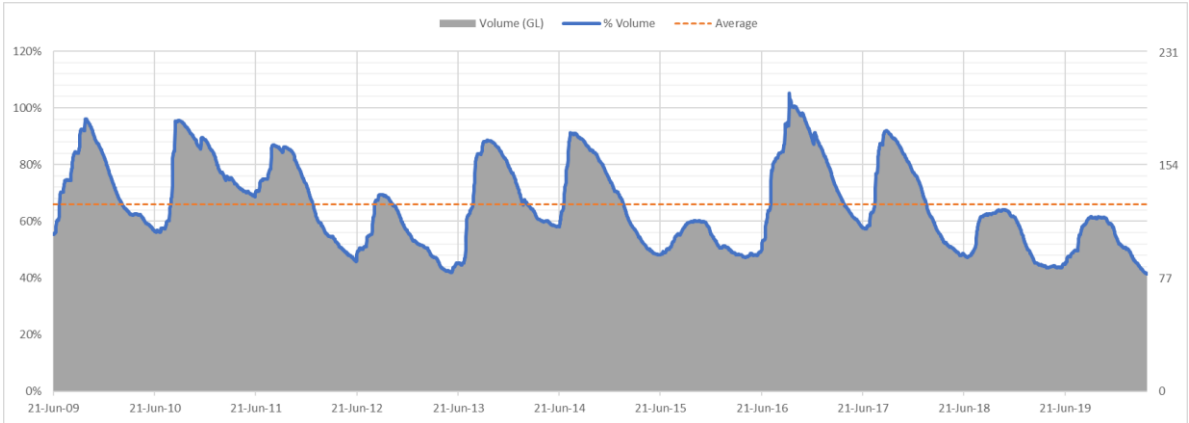
⁹ Department for Environment and Water

¹⁰ [BASINA State Shared in Storages](#)

conditions to 145 GL under Wet conditions. This modelling takes into account the volume in storages as at March 2020 and is used in the Water Balance in Table 3.

Figure 3 below shows the combined storage volumes across all WMLR reservoirs used to supply water across SA Water’s network since June 2009. Typically, inflows occur in winter and the current storage volume is around 80GL (40% of capacity).

Figure 3: WMLR storage volume since June 2009

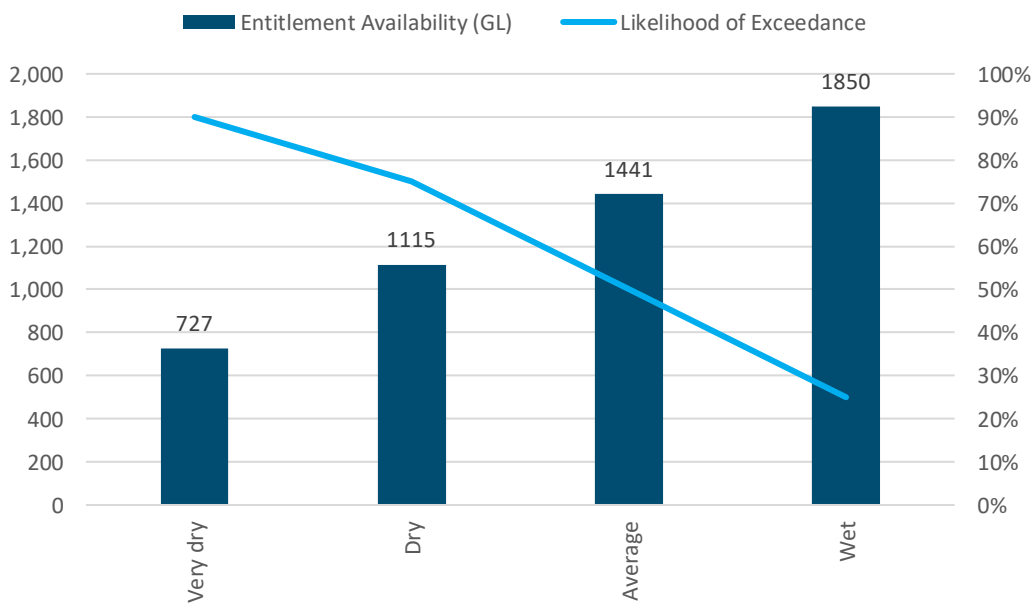


Source: SA Water and BOM Water Data Online¹¹

2.3.2 South Australia Entitlement Availability

Figure 4 below provides the expected end of year Entitlement availability and its likelihood of exceedance across four water availability scenarios. Refer to Table 2 for details on the differences between River Murray and WMLR probability of exceedances underpinning the climate outlooks.

Figure 4: 2020/21 SA Entitlement Flow Availability



Source: South Australian Department for Environment and Water

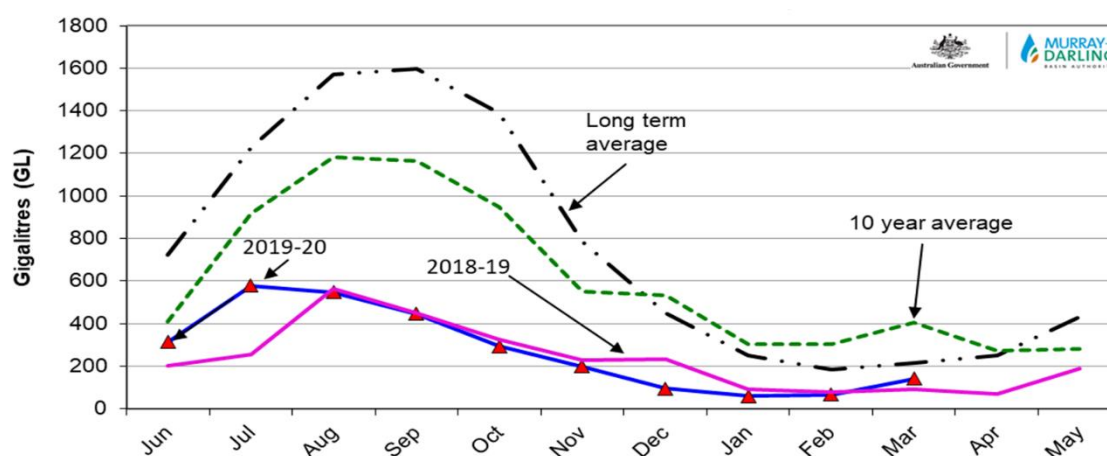
¹¹ [BOM Water Data Online](#)

For example, based on the allocation priority for South Australia in Figure 2, an allocation of 100 GL to metropolitan Adelaide CHWN and full allocation to Consumptive Entitlements requires 1,496 GL. From the figure, an entitlement availability above this is forecast to occur between Average and Wet climatic scenarios with a likelihood of exceedance between 50% and 25%, respectively.

Based on Figure 5 below, we can get an indication of the timing of inflows into the River Murray system and the resulting Entitlement allocation increases over the water year for South Australia. 2019/20 inflows have evidently been below the 10 year and long-term average with widespread drought occurring across the Basin. For the majority of this water year, it has closely resembled the 2018/19 water year.

Figure 5 also highlights that peak inflows generally occur through August and September, and as a result, it is not until the water year is well progressed that it becomes clear as to the water availability scenario that is occurring.

Figure 5: River Murray Monthly Inflow Comparison



Source: MDBA¹²

In terms of the take for Metropolitan Adelaide from the River Murray Entitlement, this is linked to a climate adjusted annual permitted take (APT) model. The permitted take model forms part of the accredited South Australian River Murray Water Resources Plan. Under the Basin Plan and accredited SA River Murray water resource plan, Metropolitan Adelaide's long-term average permitted take is 100 GL per year. Under the new arrangements, the accredited WRP model is used to determine the APT for the old Metropolitan Adelaide Cap component. Whilst this has a long-term average limit of 100 GL, it varies depending on the climate conditions in the WMLR. It may be as low as 36 GL in a wet year but greater than 150 GL in a dry year, however, the diversions for Metropolitan Adelaide should not exceed the APT, as far as practical. This new permitted take more significantly constrains the water available to be pumped from the River Murray and as such, how much can be traded from the Metropolitan Adelaide licence.

¹² MDBA River Murray Weekly Report - For the week ending Wednesday, 22nd April 2020

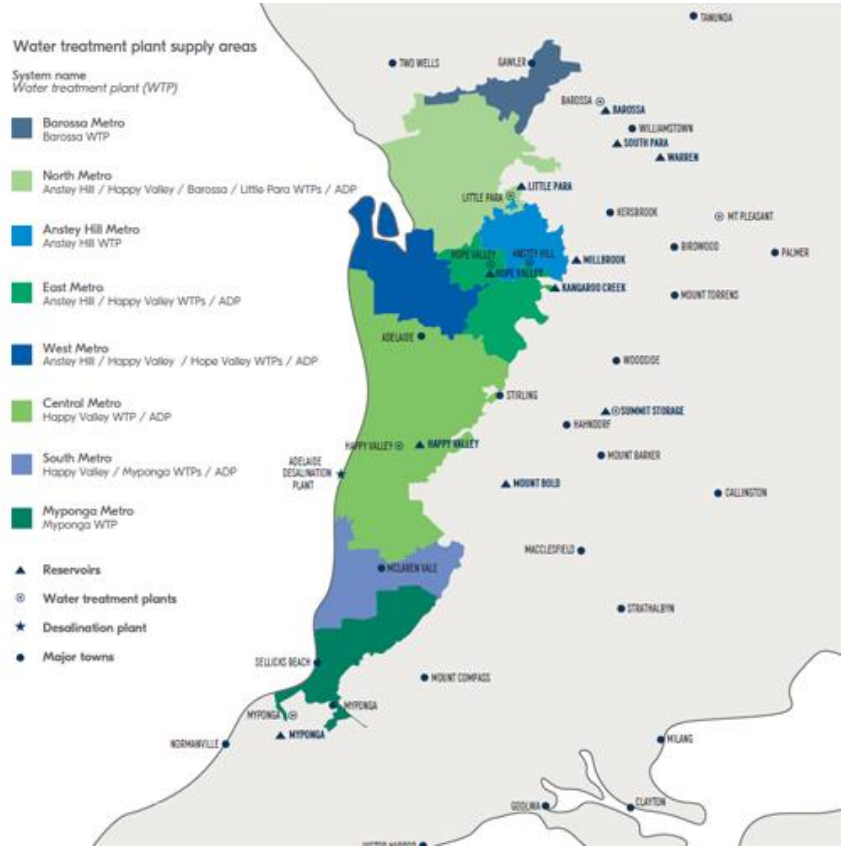
2.3.3 Adelaide Desalination Plant

The ADP has a theoretical maximum production capacity of up to 100 GL/year and is designed to provide additional water security for metropolitan Adelaide's current and future population up to 2050. However, the volume of water generated by the plant for use by Adelaide is contingent on a number of factors including:

- **Available storage:** The ADP is connected to the urban supply network upstream of the Happy Valley Reservoir, in which small volumes of ADP water may theoretically be stored. However, from a general operational perspective, this would be undesirable because of losses through evaporation from storage and the requirement to re-treat the water before it re-enters the distribution system, further adding to costs.
- **Seasonal demand:** The capacity to utilise the ADP under water demand scenarios varies significantly between and within the water year due to the timing of water availability and variability of demand. Operational requirements to maintain water-quality standards in major pipelines and at water treatment plants also influence the volume of ADP water that can be used at any one time. Adelaide's mean daily consumption ranges between approximately 560 ML/day in summer and 300 ML/day in winter. The combined minimum output from the water treatment plants (the minimum needed to maintain adequate turnover of the water in the treatment process and storage and distribution system) is about 110 ML/day. Daily demand variability can be significant, particularly in summer when demand can be plus or minus 40% of the mean daily demand of 560 ML/day, in comparison to the ADP production capacity of 300 ML/day. During winter, lower customer demand reduces the ADP's ability to replace SA Water's requirements from the River Murray. This is also influenced by essential operational and maintenance periods for the plant.
- **Distribution network:** The ADP does not currently supply water to all areas of the Adelaide metropolitan region. Therefore the overall ability of the ADP to reduce SA Water's requirements from the River Murray also needs to consider demands that are currently serviced by sections outside of the distribution network connected of the ADP.
- **Minimum River Murray Supply:** Metropolitan Adelaide take from the River Murray forms one component of surface water take for consumptive use from the South Australian Murray. The SDL component for metropolitan Adelaide, within the overall SDL for the River Murray SDL resource unit, is 100 GL per annum. The minimum River Murray pumped volume is approximately 36 GL¹³, based on supplying direct pipeline offtakes, maintaining pipeline water quality and maintaining water security for customers who cannot be directly supplied from the ADP or the WMLR.

¹³ SA Department for Environment and Water

Figure 6: Adelaide metropolitan urban supply region



Source: SA Water¹⁴

¹⁴ SA Water Networks - [Metropolitan Adelaide water supply Map](#)

2.4 2020/21 Water Balance Scenarios

To determine the production capacity of the ADP for the 2020/21 water year, it is critical to understand how the above water sources and their demand impact ADP water supply across the different climate outlooks. Table 3 below highlights the additional ADP production options across four outlooks.

The four water availability outlooks used for the purpose of this analysis have been provided by South Australia. It should be noted that these scenarios do not correlate to those used by states and the MDBA for their River Murray allocation and water availability reporting as they are related to WMLR storages:

- Very dry: 90th percentile or probability of exceedance.
- Dry: 70th percentile or probability of exceedance.
- Average: 50th percentile or probability of exceedance.
- Wet: 40th percentile or probability of exceedance.

Table 3: South Australian Water Balance

SA Water Balance Scenario	Climatic outlooks related to WMLR inflows			
	Very Dry** (90 POE)	Dry (70 POE)	Average (50 POE)	Wet (40 POE)
Water Demand (GL)				
CHWN Demand	201	190	182	177
Total resources required (incl. losses) ***	217	217	217	217
Water Supply (GL)				
WMLR Inflow	46	71	116	145
River Murray supply from South Australia's 2020/21 Entitlement	0	100	100	72
River Murray deferred storage right available for Metro Adelaide	82	46	1	0
ADP production – Adelaide and Country Towns	77	0	0	0
Total Supply	205	217	217	217
Supply balance	-12~	0	0	0
ADP additional capacity (GL)				
Maximum production	77	60	55	34
ADP production potentially available for use by the Water for Fodder program	0	60	55	34
* Scenarios relates to inflow conditions in the WMLR and subsequent demands * POE equals probability (likelihood) of exceedance ** ADP production is required under the Very Dry scenario for both Metropolitan Adelaide and for Country Towns (provided via substitution with water that would be provided to Adelaide). An entitlement allocation less than 26% (Figure 4) would require further ADP water for Country towns – this has not been modelled in this scenario. ~This volume would need to be sourced from other water sources such as the River Murray storage right, noting that this would take the volume reserved for 2021/22 CHWN below the critical level of 131 GL.				

Source: South Australian Department for Environment and Water

In summary, we note that only under a Dry climate outlook can an additional 60 GL of ADP production be made available for the Water for Fodder program without impacting on South Australia's water security.

As a consequence, we find that at this point in time, South Australia does not have sufficient water security to permit Round 2 of the Water for Fodder program.

With an estimated River Murray Entitlement of 696 GL being made available by the MDBA at the beginning of the 2020/21 water year, South Australia may need to utilise water reserved for CHWN in 2021/22 to meet demand. However, the water security for South Australia will develop over the water year and it will not be until after winter and spring inflows, that the actual water availability for the 2020 water year begins to emerge.

If water availability begins to align with specific climatic conditions, additional ADP production is potentially available for the Water for Fodder program without impacting on South Australia's water security. As discussed in 2.3.3, the requirement for the ADP to provide water for metropolitan Adelaide depends explicitly on the volumes available and required from the River Murray. This is evident in the Average and Wet climatic options where the total production capacity of the ADP is reduced. Unless there is proportionate demand for River Murray water, the additional production capacity of the ADP is constrained as it could lead to unnecessary spill from storages.

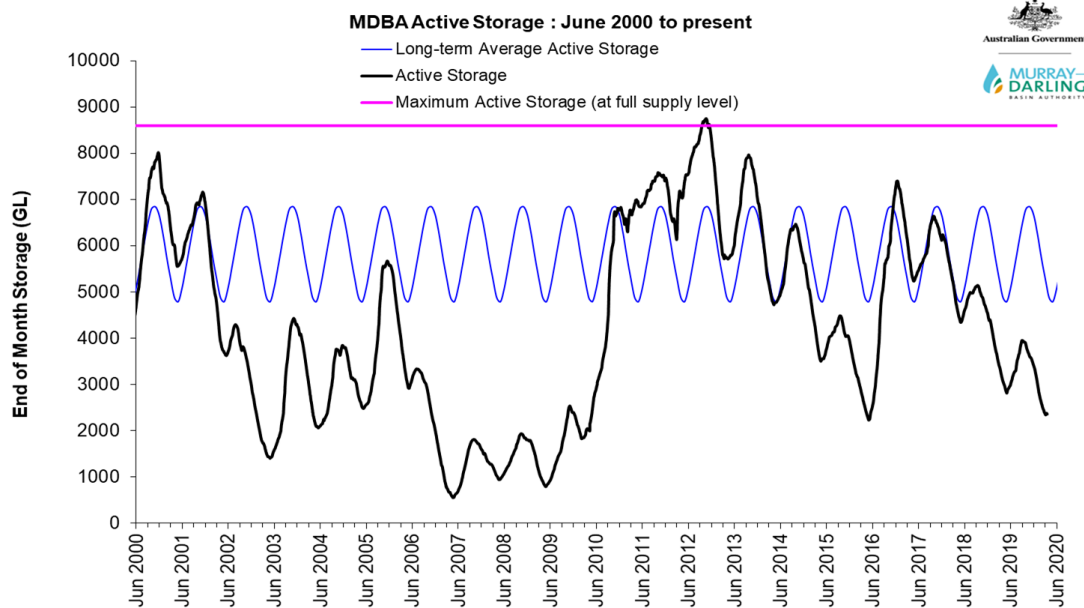
2.5 River Murray Storage Outlook

The current BOM climate outlook for the remainder of 2019/20 suggests wetter than average conditions are likely for most of Australia during the remainder of autumn and into winter. The exception is parts of the eastern seaboard, where outlooks have roughly equal chances of being wetter or drier than average.

Major climate drivers are forecast to remain neutral (El Niño–Southern Oscillation, Indian Ocean Dipole (IOD) and the Southern Annular Mode) through until the end of May 2020 with the potential for a negative IOD and weak La Niña later in the year. The combination of these two systems generally, but not always, correspond to higher than average rainfall for southeast Australia including much of the Murray-Darling Basin.

While this outlook is a significant improvement on those projected at the end of 2019, several months of above average rainfall would be required to improve water storages above the average long-term active storage levels (Figure 7).

Figure 7: MDBA Active Storage: June to Present



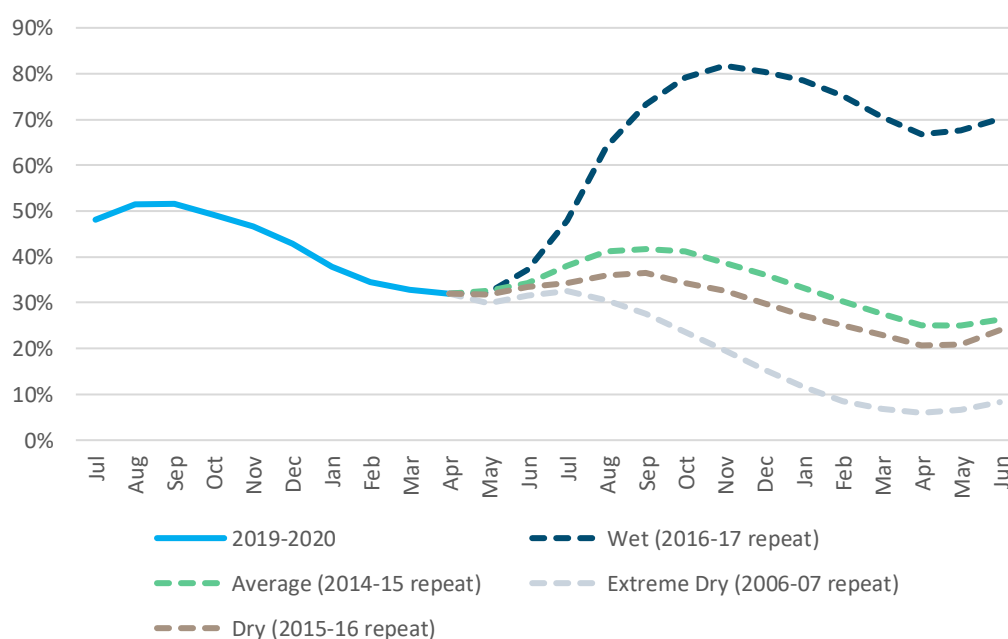
Source: MDBA¹⁵

To produce an outlook for 2020/21 River Murray storages (Figure 8), we have based projections on historical flow records. The outlook scenarios presented are:

- **Wet:** Inflows greater in 10 years out of 100, based on 2016/17 water year
- **Average:** Inflows greater in 50 years out of 100, based on 2014/15 water year
- **Dry:** Inflows greater in 90 years out of 100, based on 2015/16 water year
- **Extreme Dry:** Inflows greater in 99 years out of 100, based on 2006/07 water year

¹⁵ [River Murray Weekly Report For the week ending Wednesday, 1 April 2020](#)

Figure 8: River Murray storage (Hume and Dartmouth) projections



Source: Marsden Jacob analysis based on BoM data

The projections shown above in Figure 8 are calculated based on historical monthly average storage levels for Hume and Dartmouth dams. We have applied the corresponding changes during the scenario years using April 2020 as starting point. The results indicate that only a wet year (similar to 2016/17 water year) will result in overall higher storage levels than were witnessed in 2019/20, due to the lower storage level at start of season. However, it is critical to note that this projection is indicative only and not based on climatic or hydrological modelling.

It is important to note the situation can change rapidly. For instance, in April 2016 storage levels were similar to current levels, and there was little sign of above average rainfall occurring. Despite this, in 2016/17 very high rainfall was witnessed across the southern Basin, resulting in significant inflows to storages.

3. Water Market Allocation and Price Considerations

The total volume of water entitlements is capped and resources limited in the Basin, resulting in changes in supply and demand for water being reflected in the price of water in the water market. The high degree of hydrological connectivity in the southern Basin allows for relatively unconstrained water allocations between systems, subject to the status of trade restrictions.

As a result, the southern Basin is Australia's most significant water market and is widely regarded as one of the world's most sophisticated. Water prices are primarily driven by water availability and as a result of reduced water availability over the 2019/20 water year, allocation market prices have been persistently high across the southern Basin.

3.1 Key Findings

The key findings from this analysis are:

1. Opening allocations across the three Basin States on the River Murray have released indicative allocation outlooks. Low opening allocations are expected for range of class types including VIC High Reliability, SA Class 3 (High Security) and NSW General Security. NSW High Security is expected to open with 97% to 95% allocation depending on the zone. Unless there is significant rainfall leading to the start of the 2020/21 water year, allocations are expected to start low.
2. Marsden Jacob estimates that the average annual allocation prices in the southern Basin, under different inflow scenarios (see appendix 1 for a comparison of water availability scenarios), are as follows:
 - Extreme dry: \$800-1,000 per ML
 - Dry: \$600-800 per ML
 - Average: \$120-250 per ML
 - Wet: \$70-120 per ML

3.2 Southern Murray-Darling Basin Allocation Outlook

New South Wales, Victoria and South Australia have released indicative allocation outlooks for the 2020/21 season. It is important to note that the inflow scenarios (such as *wet*, *average* and *dry*) have different definitions between states. It is also important to note that these estimates are indicative only and are not guaranteed allocations as of the time of writing.

3.2.1 New South Wales

The preliminary outlook for 1 July 2020 water availability in the New South Wales Murray and Murrumbidgee catchments forecasts that high security allocations (97% in the Murray and 95% in the Murrumbidgee) and carryover commitments will be met on 1 July, but general security

allocations will be low or zero. The general security allocations in both catchments are expected to remain low under *extreme* and *very dry* scenarios (Table 4).

Table 4: NSW Murray and Murrumbidgee general security allocation outlooks for 2020–21

	Murray	Murrumbidgee	Murray	Murrumbidgee
Inflow scenario (POE ¹⁶)	1/09/2020		1/11/2020	
Extreme (99%)	0%	0%	0%	0%
Very dry (90%)	0%	7%	0%	9%
Dry (75%)	0%	16%	7%	29%
Mean (50%)	0%	38%	27%	60%

Source: NSW Government¹⁷

3.2.2 Victoria

The current outlook implies that without an increase in the storage volumes, opening allocations for Murray and Goulburn high reliability entitlements at the start of the 2020/21 water year are likely to be low (Table 5).

Carryover will be deliverable under all scenarios in the Murray and Goulburn, and the risk of spill in during 2020/21 is currently estimated to be less than 10% in the Goulburn and about 30% in the Murray.

Table 5: Victorian Murray and Goulburn high reliability allocation outlooks for 2020–21

Inflow scenario (POE ¹⁸)	Murray	Goulburn	Murray	Goulburn	Murray	Goulburn	Murray	Goulburn
	1/07/2020		17/8/2020		15/10/2020		17/02/2021	
Extreme (99%)	0%	0%	0%	3%	0%	9%	9%	14%
Dry (90%)	0%	1%	11%	17%	32%	36%	45%	45%
Average (50%)	9%	14%	33%	42%	62%	72%	100%	100%
Wet (10%)	31%	41%	56%	76%	100%	100%	100%	100%

Source: Vic Government¹⁹

3.2.3 South Australia

Under the current allocation outlook a minimum of 2% opening allocation has been announced for Class 3 (High Security) entitlements, and under the driest scenarios there is no improvement forecast (Table 6). As the projected minimum opening allocation is below 50%, private carryover²⁰ will be

¹⁶ Probability of exceedance out of 100 years

¹⁷ <https://www.industry.nsw.gov.au/water/allocations-availability/allocations/statements>

¹⁸ Probability of exceedance out of 100 years

¹⁹ <https://nvrn.net.au/outlooks/historical-outlooks/outlook-17-february-2020.html>

²⁰ South Australia Private carryover

available for eligible water users, allowing unused water from 2019/20 to be carried over for use in 2020/21 (up to 20% of the volume held on entitlement).

Table 6: SA Murray class 3 allocation outlook for 2020–21

Inflow scenario (POE ²¹)	1/07/2020	1/09/2020	1/11/2020	1/01/2021	1/04/2021
Exceptionally dry (99%)	2%	2%	2%	2%	2%
Extreme dry (95%)		2%	2%	2%	2%
Very dry (90%)		2%	2%	2%	2%
Dry (75%)		7%	36%	41%	42%
Average (50%)		38%	84%	90%	92%
Wet (25%)		77%	100%	100%	100%

Source: SA Government²²

3.2.4 Projected volumes available for non-environmental use

Based on the allocation outlooks it can be quantified how much allocation would be available for water entitlements across the southern Basin under different scenarios. However, whilst assessing how much water will be made available for crop production it is important to exclude allocation and carryover against water held for the environment by the Commonwealth and state environmental water managers.

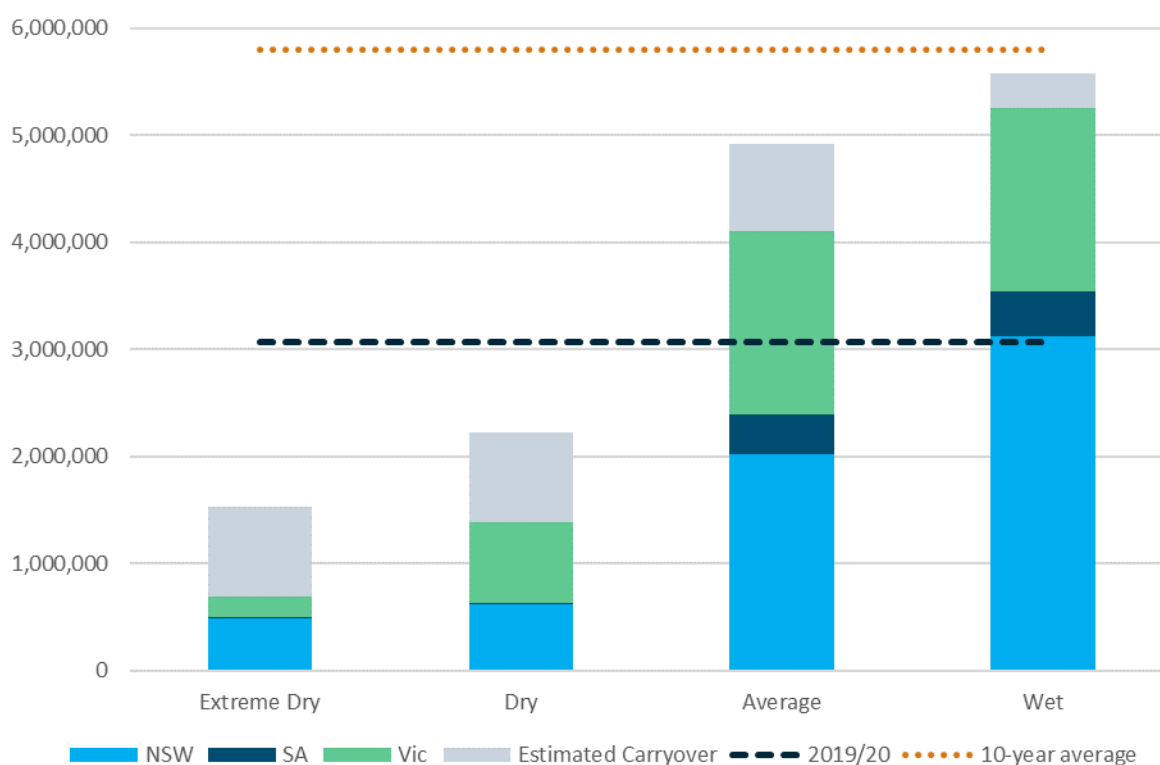
Figure 9 presents Marsden Jacob's analysis on indicative water availability for non-environmental entitlements in the southern Basin in 2020/21. This analysis takes into account the current allocation outlook and estimated carryover volumes²³ under different inflow scenarios (see Appendix 1 for details how we have harmonised the state outlooks), showing that under *extreme dry* and *dry* scenarios the forecast availability would be much lower than in 2019/20.

²¹ Probability of exceedance out of 100 years

²² [South Australia 2020 allocation outlook](#)

²³ Certain assumptions have been applied in relation to risk of spill and environmental carryover volumes

Figure 9: Forecast available water (allocation + estimated carryover minus environmental holdings) for southern Basin in 2020/21

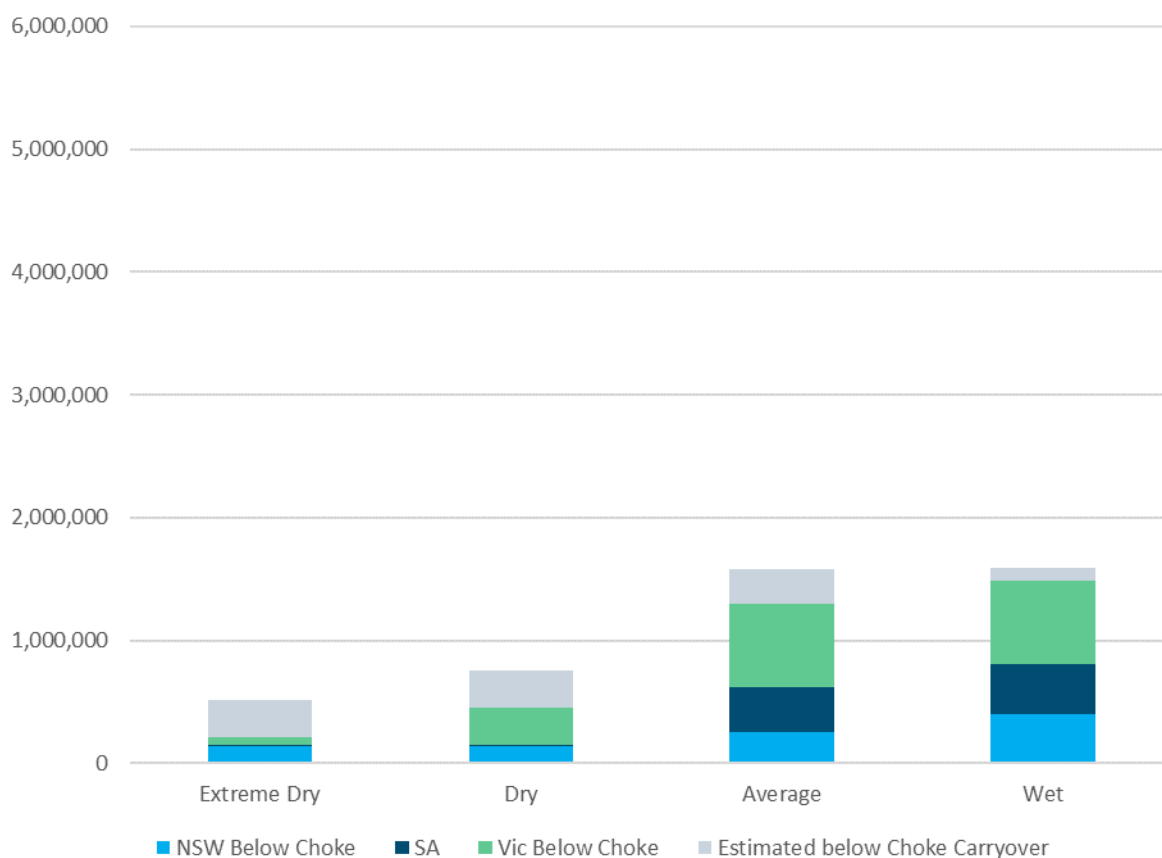


Source: Marsden Jacob analysis based on River Murray Basin State government allocation outlooks

Trade limits can have a significant impact to water availability via trade to sub-regions of the southern Basin. For instance, the forecast availability in the lower Murray (below Barmah Choke) could be up to 70% lower than the whole of southern Basin availability in 2020/21 under the worst case scenario where trade limits would restrict allocation trading downstream throughout the year (Figure 10²⁴).

²⁴ This analysis assumes that the Barmah Choke, Lower Darling, Murrumbidgee IVT and Goulburn IVT limits would restrict all allocation trade into SA Murray and NSW and Vic Murray below Choke trading zones (zones 12, 11 and 6B & 7, respectively).

Figure 10: Forecast available water (allocation + estimated carryover minus environmental holdings) for Murray below Choke areas only in 2020/21

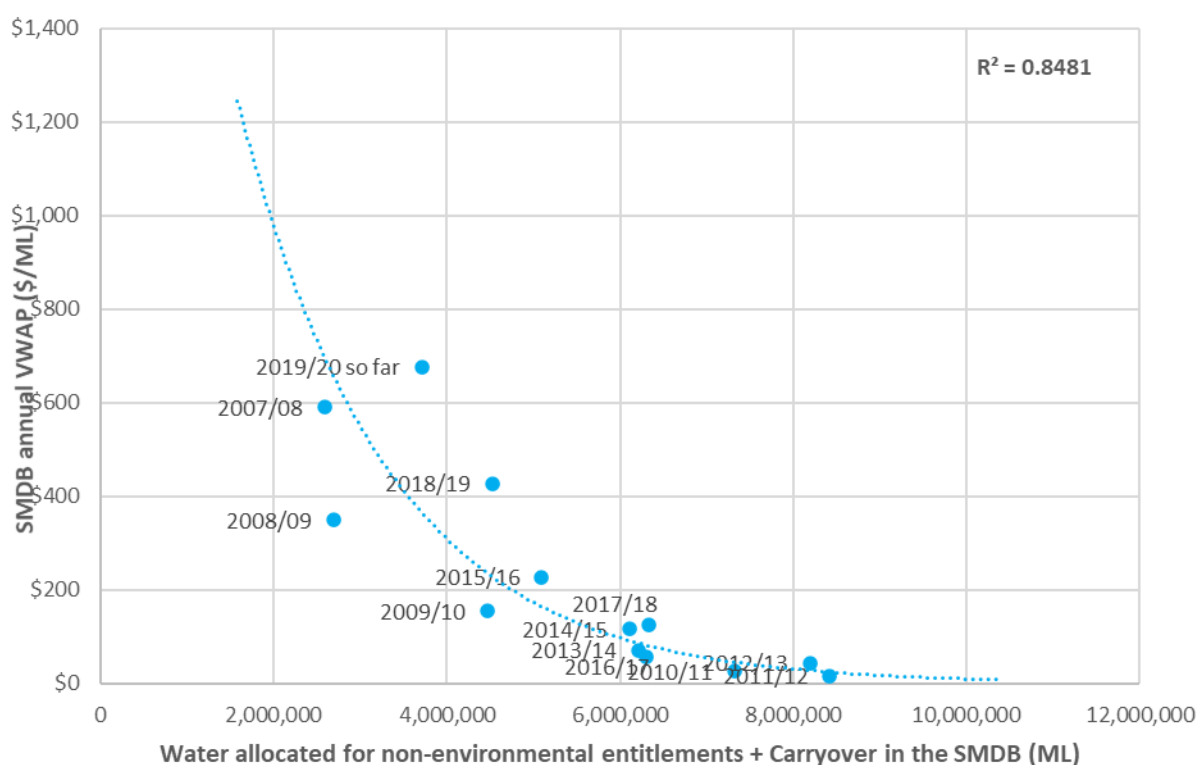


Source: Marsden Jacob analysis based on River Murray Basin State government allocation outlooks Allocation water market prices

Allocation market prices correlate strongly with water availability, making announced allocations and carryover volumes strong price drivers for the allocation water market. Figure 11 presents a high-level analysis by Marsden Jacob of how annual volume-weighted average prices²⁵ (VWAP) across the southern Basin have correlated with available water (as in the sum of announced allocations for non-environmental licences and total carryover volume in all catchments) during 2007-2020.

²⁵ Based on clean data only

Figure 11: Southern Basin annual VWAP price vs. available water 2007-2020



Source: Marsden Jacob analysis

Whilst the above model shows that the correlation between availability and market prices is strong, modelling prices simply on an annual level fails to acknowledge the intra-season variation of prices which can be significant.

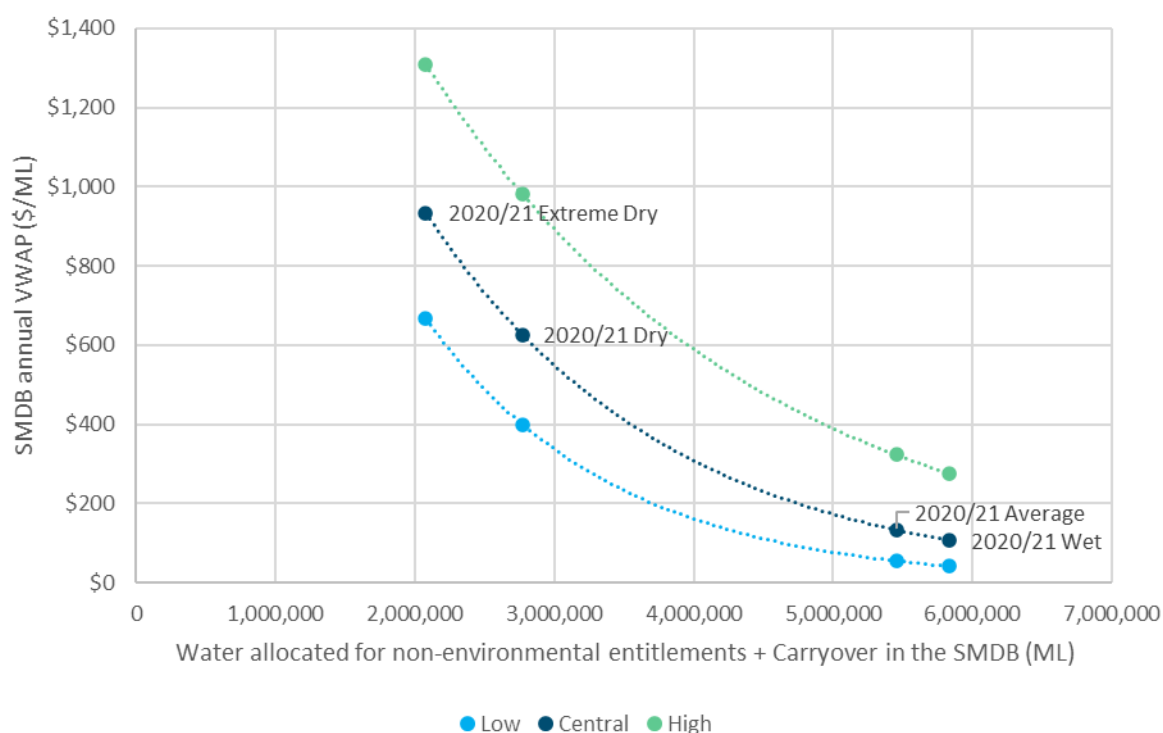
In addition, trade limits such as the Barmah Choke limit can create segregated sub-markets with price differences. Modelling allocation prices on a whole of southern Basin basis may not therefore produce accurate estimates for all catchments.

3.3 Projected Market Prices

Using the simplistic model presented in Figure 11 and forecast inflow scenarios for 2020/21²⁶, annual VWAP allocation prices for the whole of southern Basin are estimated (Figure 12).

²⁶ As per Vic, NSW and SA government allocation outlooks to February 2021 and Marsden Jacob assessment

Figure 12: Projected southern Basin annual VWAP allocation prices for 2020/21 under various inflow scenarios with upper and lower bound estimates



Source: Marsden Jacob analysis

Even though prices would ideally be modelled on a zone level, this high-level analysis clearly demonstrates the relationship between water availability and price, and that if conditions in 2020/21 remain dry, allocation prices will be high as well.

3.3.1 ABARES Market Outlook Forecast

ABARES has published recent modelling²⁷ that provides estimated allocation prices for 2020/21 on a region (zone) level under different inflow scenarios. ABARES water allocation price scenarios are presented in Table 7.

Table 7: ABARES water allocation price scenarios for 2020–21

Region	Extreme Dry (\$/ML)	Dry (\$/ML)	Average (\$/ML)	Wet (\$/ML)
NSW Murrumbidgee	838	742	422	235
VIC Goulburn-Broken	621	444	187	120
NSW Murray Above	639	576	416	272
VIC Murray Below	916	742	459	377
NSW Lower Darling	517	426	219	46
SA Murray	916	742	459	377
Weighted southern Basin average	776	735	435	293

Source: ABARES

²⁷ [ABARES Water market outlook – March 2020](#)

Under *extreme dry* and *dry* scenarios, the ABARES forecast aligns with Marsden Jacob's estimates. However, under *average* and *wet* scenarios the ABARES estimates are significantly higher than Marsden Jacob's central projection in Figure 12Figure 11. The differences stem from methodological differences and using different assumptions such as available allocations and carryover volumes, the proportion of environmental water (of all entitlements on issue), and subsequent impact to available water for consumptive use.

3.3.2 Forward Allocation Market Prices

When considering temporary water prices for the 2020/21 season, the forward allocation market has proven to be a fairly reliable price predictor for the southern Basin. According to Marsden Jacob's analysis, since 2014 (when forward markets were established in their current form) forward water prices²⁸ contracted during the previous year ended up being much below the eventual spot market price in all but one year (2016/17). Thus, the current forward water prices may represent the next season's spot market baseline, especially early on in the new season.

According to intermediaries, at this stage forward sellers are looking to obtain the following prices for an early 2020/21 delivery²⁹:

- \$625-800 per ML in the Murrumbidgee
- \$600-800 per ML in the Vic/NSW/SA Murray (below Choke); and
- \$550-700 per ML in the Vic/NSW Murray (above Choke).

3.3.3 Projected Market Prices

We note that detailed predictive modelling, which would account for in-season variance of prices in the southern Basin, would be very hard to conduct. Hence, we have drawn on our 30+ years of collective water market experience, our own modelling, ABARES estimates and the current forward market prices to estimate allocation market prices for 2020/21.

Based on these, we estimate that the average annual allocation (temporary market) price ranges in the southern Basin under different inflow scenarios are as follows:

- Extreme dry: \$800-1,000 per ML
- Dry: \$600-800 per ML
- Average: \$120-250 per ML
- Wet: \$70-120 per ML

²⁸ As reported by intermediaries

²⁹ No listings for the Victorian Goulburn market were found at the time of writing.

4. Commodity Considerations

Because the price of water entitlements is essentially equivalent to the discounted returns on water allocated to entitlements, we have undertaken margin modelling to inform our assessment of capacity to pay. Understanding a producer's capacity to pay, in combination with varying water availability and market prices, provides valuation insights into the supply of and demand for commodities.

4.1 Key Findings

The key findings from this analysis are:

1. The projected demand and consequences for products will be driven by water availability and capacity to pay. Low water allocations leading to shortfalls in water supply are likely to result in reduced areas planted to annual crops, such as cotton, rice and wheat. Demand for water to irrigate permanent crops (e.g. almonds, wine grapes) is much less responsive to water availability and market prices, because crop water supply cannot be significantly reduced without potentially affecting future plant viability. While perennial crop growers do not want to spend more for their water, fortunately they do typically have higher capacity to pay for water (see Table 9). This higher capacity to pay means irrigators of permanent crops are likely to outcompete irrigators of annual crops for the water that is available on the market.
2. Although current temporary water prices are softening as a result of recent rainfall, with some growers purchasing water in April from the spot market for carryover purposes, under dry and extreme dry scenarios, there is less water available next water year than was the case for 2019/20. Those irrigators who have higher capacity to pay can afford to enter the spot market, while those commodities with lower capacity to pay will be at a higher risk of being able to gain water at a reasonable cost and ensure continued sustainability.

4.2 Commodity Demand

Annual water market demands, by enterprise, have been estimated by ABARES since 2006. However, Table 8 details water demands and trends only between 2013 and 2018³⁰. Over this period, water demand has been most variable for the following enterprise types: rice, dairy, other cereals (includes wheat), and pasture for grazing. In contrast, demand has been most stable for: vegetables, fruit, pastures for hay, and grapevines. Almonds and cotton have been excluded from the above lists due to their water demands trending up significantly over the same period, rather than increasing or decreasing based on annual water availability. Over this time, annual water demand has increased by an average of 9% p.a. for almonds and 12% p.a. for cotton, while annual area watered has increased by an average of 10% p.a. for almonds and 12% p.a. for cotton.

Trends for annual water demands to be relatively variable or stable, as described above, closely align with the distinction between annual and permanent crops. Permanent crops cannot be readily scaled

³⁰ 2018 is the most recent year for which data are available.

from year-to-year and are reliant on receiving adequate water each year to survive. On the other hand, annual crops (e.g. rice, wheat) are easily scaled each growing season, in response to water availability.

Therefore, any eventual shortfalls in water supply are likely to result in reduced areas planted to annual crops, such as cotton, rice, and wheat. Demand for water to irrigate permanent crops (e.g. almonds, wine grapes) is much less responsive to water availability and market prices, owing to a higher capacity to pay for irrigating these crops (see Table 9). This higher capacity to pay means irrigators of permanent crops are likely to outcompete irrigators of annual crops who have a lower capacity to pay.

It is also worth noting that, although cereal crops (e.g. wheat) can be used for fodder, this is not typically the main reason why they are grown. Instead, cereals are commonly grown as rotational crops, either dryland by utilising residual soil moisture from summer irrigation activities or irrigated using surplus water.

Furthermore, although annual crops are unlikely to generate returns similar to permanent crops, there may be situations where annual crops are part of a mixed farming business where margin returns can be attributed across multiple commodities such as wheat grown to raise livestock. In these cases, the additional returns from livestock maybe sufficient to justify a higher capacity to pay.

Table 8: Range of annual water demands for selected crops in the southern Basin

Annual demand 2013-2018 (GL)	Almonds	Wine grapes	Cotton	Pastures for Hay	Rice	All other uses	Total
Minimum	292 ('13)	388 ('17)	264 ('15)	324 ('16)	299 ('16)	2,031 ('16)	3,731 ('16)
Average	387	435	345	346	860	2,934	4,563
Maximum	452 ('18)	477 ('13)	543 ('18)	366 ('18)	1,434 ('13)	3,912 ('13)	5,419 ('13)
Trend	↑	↔	↑	↔	↔	↔	↔

Source: Marsden Jacob estimates informed by ABARES datasets (2020)³¹

4.3 Commodity Margin Analysis

From a margin return perspective, the value of water 'in use' depends on several factors, including:

- Output (i.e. crop) prices
- Input prices (e.g. fertiliser, labour)
- Weather conditions (e.g. in-season rainfall, temperature), which affect yields

Therefore, it is considered appropriate to report a range of values of water, rather than a point estimate (Table 9). These estimates are incremental to a 'do nothing' base case (i.e. no dryland crop).

³¹ Gupta, M, Westwood, T, Legg, P 2020, Basinwater market dataset, ABARES technical report, Canberra, March, CC BY 4.0. <https://doi.org/10.25814/5e781e73a1b9a>

Table 9: Indicative margin returns for selected crop types in the southern Basin

Bounds (\$/ML)	Almonds	Wine grapes	Cotton	Wheat	Lucerne (Hay)	Rice
Upper bound gross margin (higher yielding producer)	2,200	1,500	500	500	400	400
Lower bound gross margin (lower yielding producer)	750	500	200	175	150	150

Source: Marsden Jacob analysis of various gross margin budgets

Further, it should be noted that, for some irrigators, any forgone margin returns owing to low water availability, might be smaller than those reported above. This is because, after receiving a low or zero general security allocation, some irrigators will grow a dryland crop, or downscale the irrigated crop area. However, for most irrigators, soil moisture levels in 2019/20 are likely to have been insufficient to encourage irrigators to plant a dryland crop, meaning a 'do nothing' base case is appropriate.

Also, it is unlikely that the upper bound would have been achieved by the majority of producers. Therefore, a more conservative approach is recommended, where the average impact of lower water availability on producers means returns would likely be nearer the lower bound, in the absence of other evidence.

It should also be noted that the estimated crop margins and the value of forgone irrigated production are estimated on an indicative basis, and that the modelling does not take into account practicalities such as if the water was made available at a suitable time (i.e. within the planting window for that crop) for the irrigator to grow a crop and thus make a financial return from crop production. The models simply assume that any surplus water can be used to generate that return according to our estimated crop margins. It is also important to note that a gross margin does not equate to profit because it does not include fixed or overhead costs such as depreciation, interest payments, rates and permanent labour, which have to be met regardless of enterprise size.

The margin analysis has relied on gross margin budgets from a range of sources. Some of these budgets are older than ideal, which has been addressed by updating input prices in the original budgets to reflect current prices. However, best management practice guidelines and actual farming practices might also have changed since the original budgets were published.

Irrigation requirements have been adjusted to reflect differences between local growing conditions and those of the original budgets used.

Published gross margin budgets (e.g. NSW DPIE, AgMargins) are based on average or representative farms. In practice, some farms will outperform, and others will underperform, relative to average farms. Therefore, when using margin analyses as the basis for price outlooks, it is prudent to report a range of feasible values rather than a point estimate.

4.4 Commodity Outlook and Demand

Overall, as discussed in Section 3, the outlook for water availability appears to be worse now than it was 12 months ago. However, the current rainfall and streamflow forecast is cause for a limited degree of optimism.

The current BOM climate outlook for the remainder of 2019/20 suggests wetter than average conditions are likely for most of Australia during the remainder of autumn and into winter, with the outlooks for key climate drivers corresponding to higher than average rainfall for southeast Australia, including much of the Basin. While this outlook is a significant improvement in weather conditions relative to those projected at the end of 2019, it is important to note that several months of above average rainfall would be required to significantly improve water storages from their current levels.

Further, underpinned by recent rain, temporary water prices are softening, with some growers purchasing water today from the spot market for carryover purposes. Under dry and extreme dry scenarios, however, there is less water available. Those irrigators who have higher capacity to pay can afford to enter the spot market, while those with lower capacity to pay will be priced out of the market (see Section 4.3). Although some growers might have access to other sources of water, such as groundwater or unregulated water, or temporary water purchased at a lower price through a long-term lease arrangement, the ability to grow fodder under these conditions is likely to be suboptimal.

Other considerations are that:

- Some fodder crops (e.g. wheat) are rotational. Many irrigators will grow a summer crop (e.g. rice), then utilise the residual soil moisture to grow a winter crop. If growers have not grown a summer crop (e.g. due to low water availability), their ability to grow a winter crop thus may be compromised.
- The wine industry, which is heavily export focussed, might be in a vulnerable position owing to international supply chain issues. Growers of white wine varieties are likely to be even more vulnerable due to current low prices.

The range of potential annual water demands outlined in Table 10 is based on analysis of data from ABARES (2020)³². The demands are based on the area watered for each crop type in 2018 (the most recent data available), with the ranges based on historical irrigation application rates – the highest and lowest application rates over 2013 to 2018. Note that the average water demand for permanent plantings shown in Table 10 closely aligns with ABARES's estimate³³ that 1,276 GL will be used on average each year for horticultural plantings, under modelled future scenarios.

³² Gupta, M, Westwood, T, Legg, P 2020, Basin water market dataset, ABARES technical report, Canberra, March, CC BY 4.0. <https://doi.org/10.25814/5e781e73a1b9a>

³³ Panel report: Independent assessment of social and economic conditions in the Basin (Draft report). <https://www.basin-socio-economic.com.au/47038/widgets/283883/documents/162810>

Table 10: Range of potential annual water demands (GL), based on area watered in 2018 and historical application rates (ML/ha)

Water demand scenario	Almonds	Horticulture (excl. almonds)	Viticulture	Total permanent plantings
Low ³⁴	360	300	300	960
Average	500	420	420	1,340
High ³⁵	680	520	520	1,720

Source: MJA analysis of ABARES (2020)³⁶

Table 10 takes into account all water use, including surface water and other sources such as groundwater. Comparing these figures to forecast water availability, it is clear that under the extreme dry (1,534 GL available) and dry (2,227 GL available) scenarios, surface water availability is not sufficient for all irrigation activities. If these scenarios eventuate, the water use for relatively lower value crops (e.g. rice, cotton, wheat) starts to decrease, as is also suggested by the margin analysis (see Section 4.3).

Fortunately, there should be enough water available to sustain permanent plantings, except possibly under the driest scenario. However, if trade limits restrict water from being traded to its highest value use, as per the extreme example presented in Figure 10, permanent plantings in the lower Murray might not receive enough water. Although some growers might have access to other sources of water, such as groundwater or unregulated water, or temporary water secured at a lower price through a long-term lease arrangement, the ability to grow fodder under these conditions is likely to be suboptimal, because there are higher value alternative uses of the water.

³⁴ This scenario is based on the lowest average application rates (ML/ha) for each crop type over the period 2013 to 2018, minus 20%. It is reflective of a high rainfall/high soil moisture scenario.

³⁵ This scenario is based on the highest average application rates (ML/ha) for each crop type over the period 2013 to 2018, plus 20%. It is reflective of a low rainfall/low soil moisture scenario.

³⁶ Gupta, M, Westwood, T, Legg, P 2020, Basin water market dataset, ABARES technical report, Canberra, March, CC BY 4.0. <https://doi.org/10.25814/5e781e73a1b9a>

Appendix 1 – Water availability scenarios

The definition of outlook scenarios and the level of information provided can vary by state water agency. The Marsden Jacob outlook scenarios used in this report are matched against the state outlook scenarios in Table 11. These outlooks have been produced by the following State agencies:

- Northern Victoria Resource Manager (NVRM)
- NSW Department of Planning, Industry and Environment (DPIE)
- SA Department for Environment and Water (DEW)

Table 11: Marsden Jacob outlook scenarios matched against state outlook scenarios and assumptions used

Marsden Jacob scenario equivalent + assumptions	NVRM scenario	SA DEW scenario	NSW DPIE scenario
Extreme dry	Extreme dry	Exceptionally dry	Extreme
• NVRM outlook to Feb 2021 • DEW scenario to Apr 2021 • DPIE scenario to Nov 2020 (assumes no improvement till end of season)	Inflow volumes to storages that are greater in 99 years out of 100	99% likelihood that actual allocations will exceed allocation forecast	99 chances in 100 of exceeding the allocation forecast
Dry	Dry	Very Dry	Very Dry
• NVRM outlook to Feb 2021 • DEW scenario to Apr 2021 • DPIE scenario to Nov 2020 (assumes no improvement till end of season)	Inflow volumes to storages that are greater in 90 years out of 100	90% likelihood that actual allocations will exceed allocation forecast	9 chances in 10 of exceeding the allocation forecast
Average	Average	Average	Mean

Marsden Jacob scenario equivalent + assumptions	NVRM scenario	SA DEW scenario	NSW DPIE scenario
- NVRM outlook to Feb 2021 - DEW scenario to Apr 2021 - Adjusted DPIE scenario (assumes 10% improvement in the Murrumbidgee and 18% improvement in the Murray from Nov 2020 till end of season)	Inflow volumes to storages that are greater in 50 years out of 100	50% likelihood that actual allocations will exceed allocation forecast	1 chance in 2 of exceeding the allocation forecast
Wet	Wet	Wet	Wet
- NVRM outlook to Feb 2021 - DEW scenario to Apr 2021 - Marsden Jacob assumption for NSW (assumes 100% end of season allocation for Murray and Murrumbidgee for HS and GS)³⁷	Inflow volumes to storages that are greater in 10 years out of 100	25% likelihood that actual allocations will exceed allocation forecast	NSW has not released a forecast for this scenario

³⁷ For Lower Darling, all scenarios assume 100% HS allocation. GS allocation is expected to be 0% in all scenarios except for Wet (100% then).