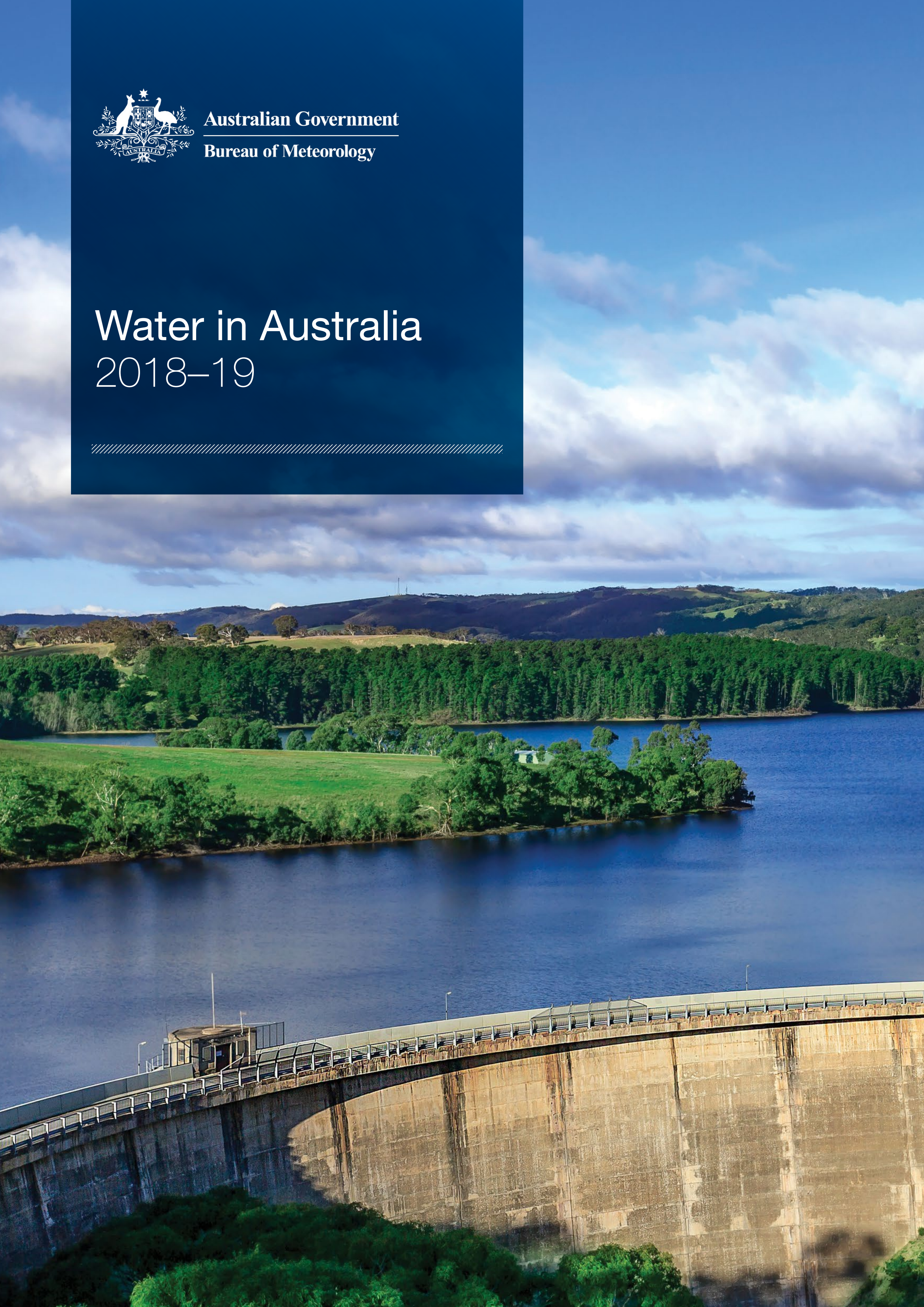
Australian Government

Bureau of Meteorology

Water in Australia

2018–19



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Cover: Myponga reservoir, South Australia (akshaystudios, iStock)

Foreword: Lake Wivenhoe, Queensland (RobertDowner, iStock)

Page 2: Lake Eildon, Murray–Darling Basin region (Alison Pouliot © 2009)

Page 5: Wheat harvesting, Murray–Darling Basin region (MDBA © Arthur Mostead)

Introduction: Meandering rivers and mangroves of Hinchinbrook Island, Queensland (Coral_Brunner, iStock)

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FOREWORD

The health of our communities, industries and natural environments is dependent on secure water supplies. High year-to-year variability in rainfall and increasing demand for water resources presents unique challenges for water management in Australia. Responding to these challenges requires reliable and transparent information on the state of our water resources.

More than 200 organisations across Australia collect data on water availability and use. This is provided to the Bureau of Meteorology, which analyses and integrates the information, and makes it publicly available on the Bureau's website.

Water in Australia 2018–19 is the sixth in a series of annual reports and covers the period from 1 July 2018 to 30 June 2019. It pulls together the latest data and analysis from across the Bureau to provide a national overview of Australia's water availability and use in the context of longer-term trends and climate influences. The information in the report will be of value to government agencies, policymakers, researchers, industry, educators and students looking for insight into the key water issues faced across the country during 2018–19.

Water in Australia provides information at the national level while more detailed information for eleven nationally significant water management regions is provided in the *National Water Account*. The reports complement each other and together provide a complete picture of water resources situation in Australia.

I would like to acknowledge the many agencies who provide their data to the Bureau and make this report possible, along with the many experts responsible for the analysis. The Bureau is constantly seeking to increase the value we deliver to the Australia community and would appreciate feedback via water@bom.gov.au.

Matthew Coulton
Acting General Manager Water
Bureau of Meteorology

OVERVIEW

- **Dry conditions were experienced across most of Australia for the second successive year.**
- **Storage volumes in parts of southeastern Australia were the lowest in more than ten years.**
- **Total water taken for consumptive use in Australia was 15 100 GL, 10 per cent less than the previous year.**

CLIMATE AND WATER

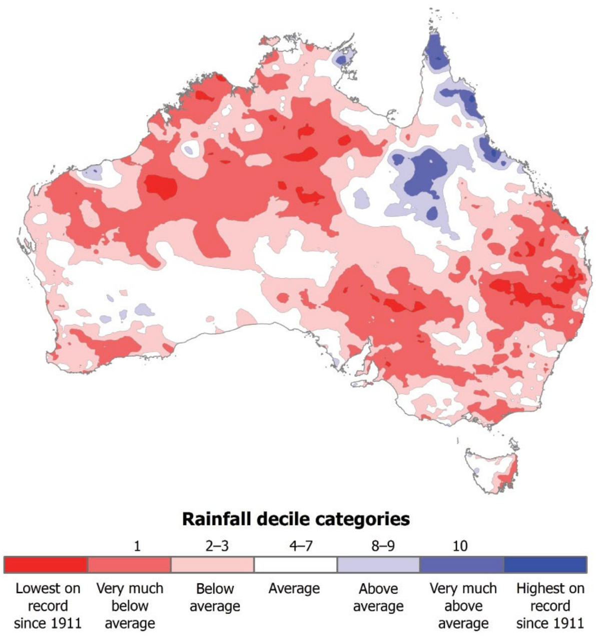


Figure I. Annual rainfall during 2018–19 compared with historical records (1911–2019)

- Australia's total annual rainfall in 2018–19 was 351 mm, the lowest in almost 50 years.
- Below-average annual rainfall over much of Australia led to an intensification of drought conditions across many parts of southeastern Australia, particularly the northern parts of the Murray–Darling Basin.
- Northwestern Australia was also dry, with a delayed monsoon onset contributing to a below-average wet season.
- Annual rainfall was high across northern Queensland due to an intense monsoon low that impacted the region in late January to early February 2019.

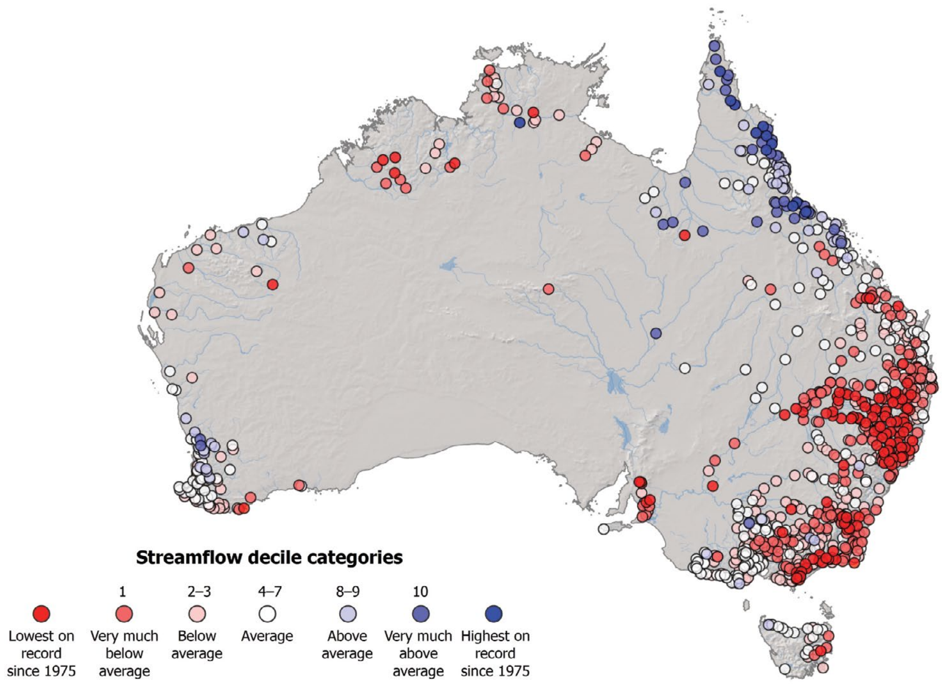


Figure II. Streamflows during 2018–19 compared with historical records (1975–2019)

- Streamflow in most rivers across southeastern Australia was lower than average and many rivers recorded their lowest annual flows on record, particularly across northern New South Wales.
- Several rivers in northern Queensland recorded their highest annual flows on record. Heavy rainfall in early 2019 produced extensive flooding in Townsville, major flooding in the Burdekin River and high flows into Kati Thanda–Lake Eyre.
- Groundwater levels across much of Australia were also lower than average. Most of the aquifer bores had stable or declining trends in water level.

- Total accessible surface water storage for Australia at 30 June 2019 was 23 002 GL or 46 per cent full, 17 percentage points less than the same time last year.
- Dry conditions across southeastern Australia meant storage volumes in some of the major storage systems across the Murray–Darling Basin were less than 20 per cent full and much lower than the previous year, particularly in the northern part of the Basin.
- End of year storages in South East Queensland and Sydney were the lowest in more than 10 years, and for Canberra and Melbourne, the lowest since 2010.
- Most of the rural systems in northern Queensland had storage levels above 80 per cent full, reflecting the heavy rainfall and flooding in January–March 2019.

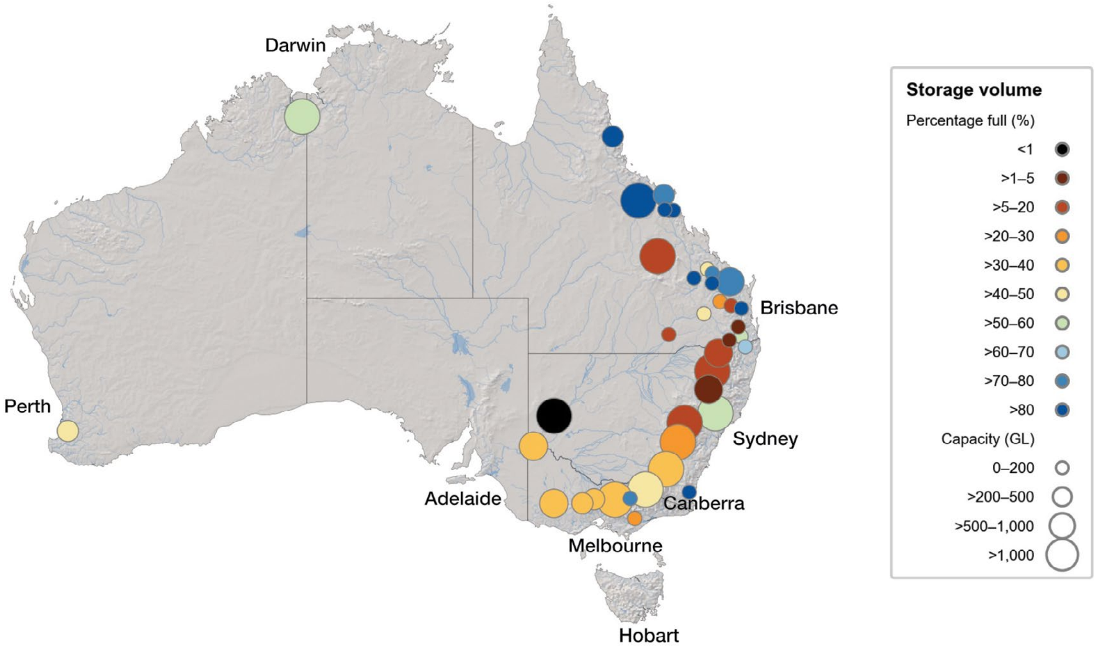


Figure III. The distribution and storage status of rural storage systems at 30 June 2019

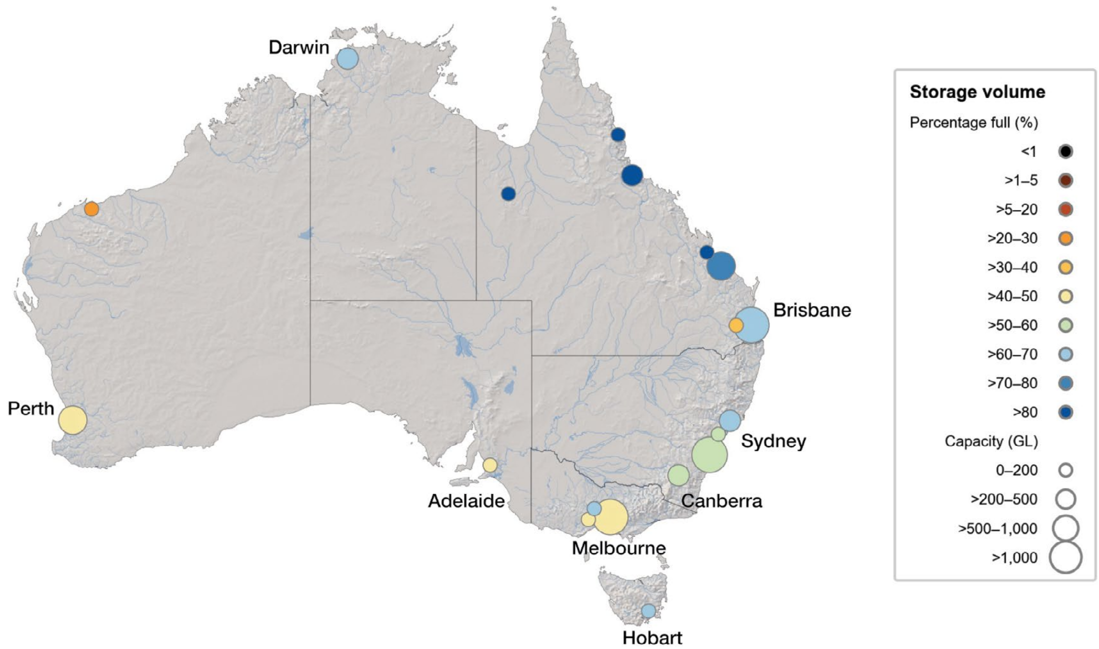


Figure IV. The distribution and status of urban storage systems at 30 June 2019

WATER SOURCES AND SUPPLY

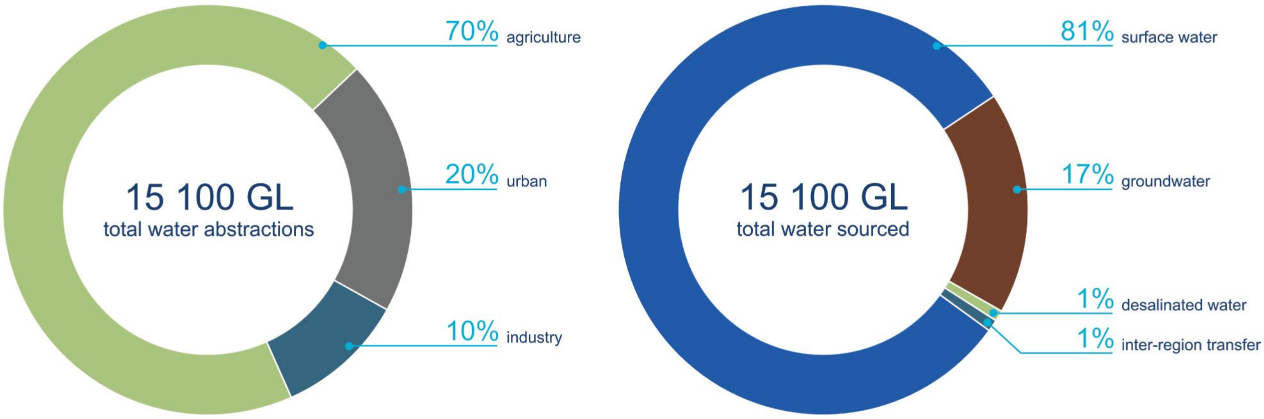


Figure V. Water taken by use category and source in 2018–19

- Total water taken for consumptive use in 2018–19 was 15 100 GL, 10 per cent lower than the previous year.
- Surface water was the primary water source, particularly for agriculture, due to its easy accessibility and low abstraction cost.
- Total water taken for agriculture decreased by 14 per cent from 2017–18, largely due to the dry conditions and lower water availability across the Murray–Darling Basin. The portion of total water sourced from groundwater increased from the previous year, due to the low surface water availability for agriculture.
- The portion of total water sourced from groundwater increased from the previous year due to the low surface water availability for agriculture.
- Twenty per cent of total water taken was provided for urban water supply. More information on Australia's urban systems is available in the Bureau's National Performance Report 2018–19.
- The dry conditions and low water availability resulted in a 24 per cent decrease in the volume of water allocations traded compared to 2017–18 but a tripling of average allocation prices due to strong demand for the limited available water. More information on Water Markets across Australia is available in the Bureau's Australian Water Markets Report 2018–19.

1 INTRODUCTION

Australia has a highly variable hydrologic regime, with frequent impacts from floods and hydrological drought. With much of the country arid or semi-arid, Australia has a high reliance on water to sustain communities, industries, the environment and agriculture. Access to reliable water resources is a key to the prosperity and sustainability of urban and rural communities, particularly through times of drought and water scarcity. Periodic assessment and reporting provide essential insights into the use of these limited water resources.

The Bureau of Meteorology is responsible for compiling and delivering comprehensive and transparent information about water resources across Australia to help inform decision-making by water managers and policymakers. Under Part 7 of the *Water Act 2007*, the Bureau of Meteorology is required to collect, hold, manage, interpret and disseminate Australia's water information. As part of this role, the Bureau publishes an annual overview of Australia's water resources and use in the context of long-term patterns and climatic influences.

Water in Australia 2018–19 is the sixth in a series of annual reports. It integrates data and investigations from across the Bureau to provide a national overview of the status of Australia's water resources availability and use for the period from 1 July 2018 to 30 June 2019. *Water in Australia* provides information at the national level while more detailed information for eleven nationally significant water management regions is provided in the National Water Account.

Chapter 2 of this report provides an overview of water resources availability in Australia during 2018–19. It starts with an overview of climatic drivers during the year together with the resultant rainfall distribution. National annual and monthly streamflow deciles are then discussed. An overview of surface water storages and groundwater resources is presented, as well as contributions from climate-independent water sources such as desalination and recycling. The chapter also examines streamflow and groundwater salinity and discusses how these may constrain water use.

Chapter 3 of the report begins with an overview of water trading and then summarises water abstractions for agricultural, urban and other industrial uses. Water stress in Australia is estimated and reported using a United Nation's indicator of water stress. Water use by environmental water holders and Aboriginal cultural water needs are then discussed. Groundwater extractions are considered in Australia's groundwater management areas and water availability is compared to use in National Water Account areas.

Water in Australia and related resources are available on the Bureau's website.[1] The information presented in this report is based on the best data available at the time of writing. Datasets used to generate this report are available for download through specific information sources available at the Bureau of Meteorology website.

- Regional Water Information[2] provides spatial and temporal information and summaries (from nationwide to the river region level) on the status of water resources and use.
- Monthly Water Update[3] provides a snapshot of monthly rainfall, streamflow, stream salinity and storage volumes for ten of Australia's 13 drainage divisions.
- Groundwater Information Suite provides data on bore water levels and trends, and associated data on hydrogeology and groundwater management (www.bom.gov.au/water/groundwater/index.shtml).
- Australian Landscape Water Balance provides Australia-wide information on key landscape water balance components, including soil moisture, runoff, evapotranspiration, deep drainage and precipitation in near real time (www.bom.gov.au/water/landscape).

1 www.bom.gov.au/water/waterassessments
2 www.bom.gov.au/water/rwi
3 www.bom.gov.au/water/monthly-water-update

- National Water Account is a detailed annual accounting of water assets and liabilities for 11 key water-use regions (www.bom.gov.au/water/nwa/2019).
- Urban National Performance Reports provide annual benchmarking of the performance of 80 urban water utilities and councils and five bulk water authorities (www.bom.gov.au/water/npr/index.shtml).
- Water Data Online provides watercourse level, watercourse discharge, storage level, storage volume, electrical conductivity, turbidity, pH and water temperature information from approximately 5000 water monitoring stations across Australia, many of which are updated daily (www.bom.gov.au/waterdata).
- Water Storage Dashboard allows comparison of water levels and volumes for more than 300 publicly owned lakes, reservoirs and weirs in different States and Territories, and shows how much water is available over the entire country (www.bom.gov.au/water/dashboards/#/water-storages/summary/state).
- Water Markets Dashboard allows viewing and comparison of the volumes and prices of water entitlements and allocations being traded in Australia. One can also view the number and volume of entitlements that are on issue nationally (www.bom.gov.au/water/market).
- Water Focus Reports provides timely and concise insights into recent hydrological events of interest to our customers, partners and the public (www.bom.gov.au/water/focus)

Rainfall values reported in *Water in Australia* are obtained from Regional Water Information and were correct at the time of the analysis. Values may differ from those shown in other Bureau of Meteorology products due to subsequent updates and small differences in geographical boundaries used in the various products.

2 WATER RESOURCES

This chapter provides an overview of water resources availability in Australia during 2018–19. Section 2.1 provides a summary of climatic conditions and drivers during the year together with the resultant annual and monthly streamflows. Section 2.2 shows the effects of these patterns on water storages. Section 2.3 examines the salinity of the streamflow and discusses how this may constrain water use. An overview of groundwater resources is presented in terms of three main aquifer groups in Section 2.4. The contributions from climate-independent water sources, such as desalination and recycling, are reported in Section 2.5.

2.1 CLIMATIC CONDITIONS, RAINFALL AND STREAMFLOW

2.1.1 National rainfall

The area-averaged annual rainfall across Australia for 2018–19 was 351 mm, 24 per cent less than the mean value (based on data from 1911–2019) of 460 mm. This was the fourth lowest rainfall on record and the lowest since 1969–70.

The below average rainfall over much of Australia led to an intensification of drought conditions across many parts of southeastern Australia. Some areas in the northern part of the Murray–Darling Basin experienced their lowest rainfall on record (Figure 1). Northwestern Australia was also relatively dry, with a delayed monsoon onset contributing to a below average wet season. In the Northern Territory, annual rainfall was the lowest since 1963–64.

Large areas of above average rainfall only occurred across parts of central and northern Queensland (Figure 1). Rainfall was high across northern Queensland due to an intense monsoon low that impacted the region in late January to early February 2019. Western and central Queensland received further widespread rainfall from ex-tropical cyclone *Trevor* in March 2019.

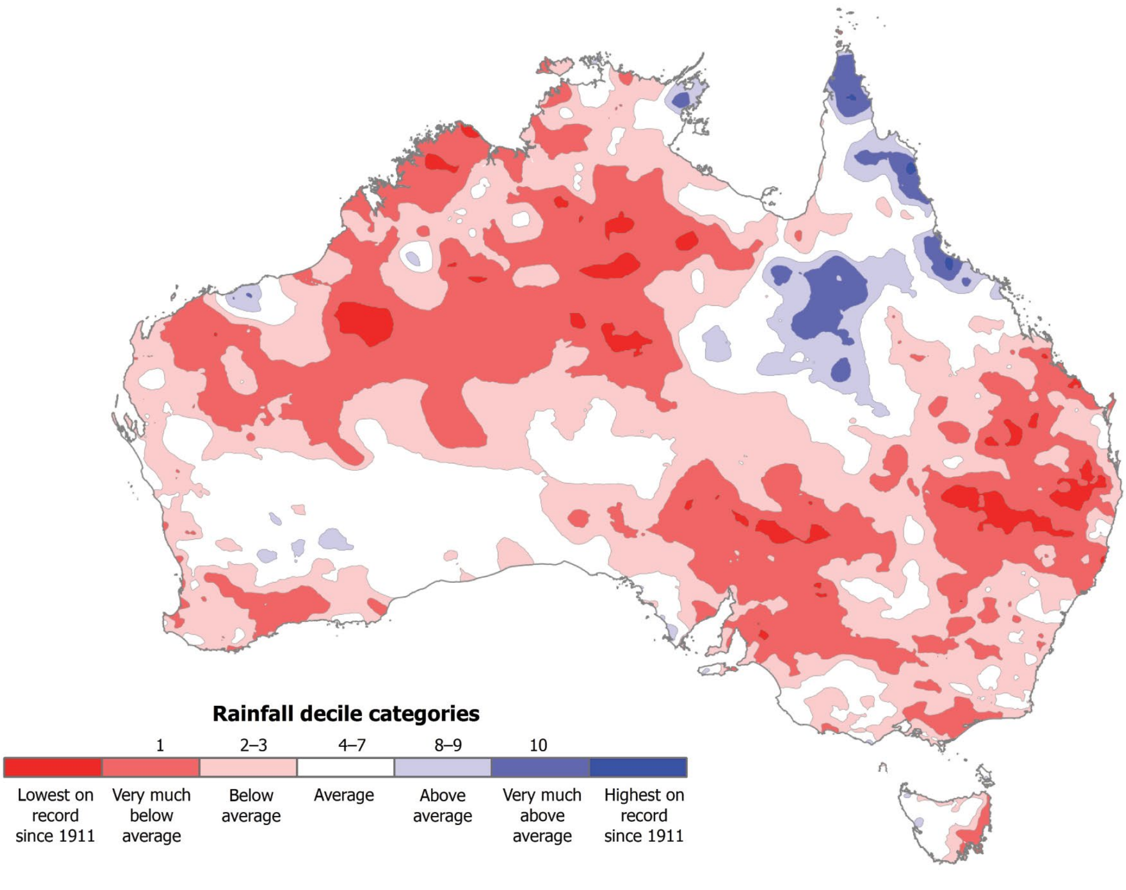


Figure 1. Rainfall deciles map for 2018–19

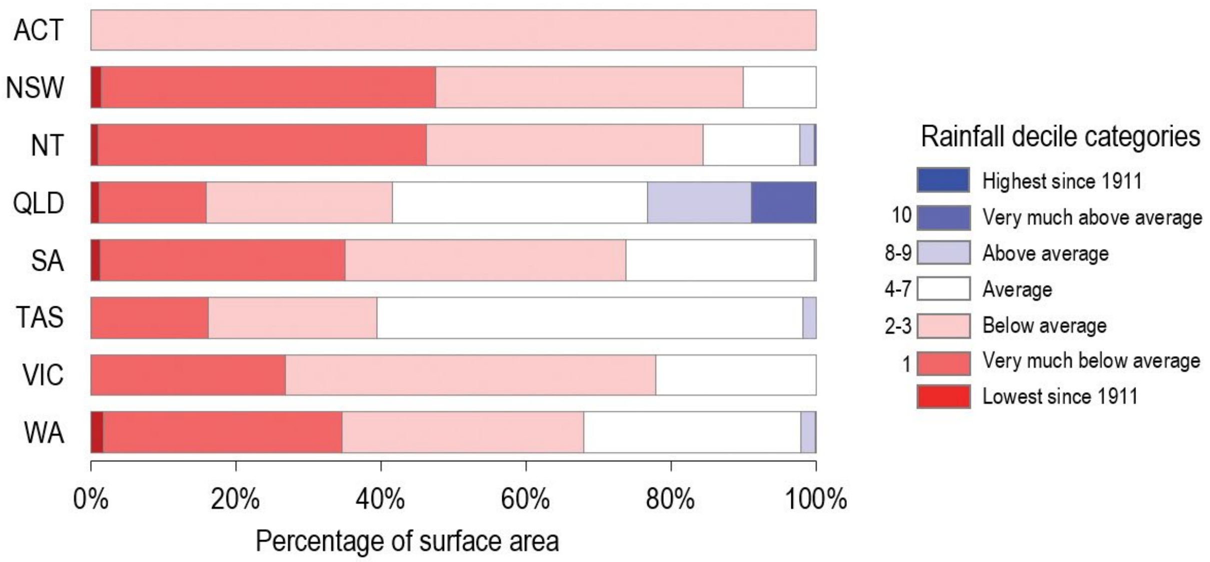


Figure 2. Percentage of each State and Territroy in the different rainfall deciles in 2018–19

Annual rainfall was lower than average for over two thirds of Australia as well as in most States and Territories (Figure 2). In New South Wales and the Northern Territory, almost half of the surface area experienced very much below average rainfall.

In contrast, Queensland and Tasmania were the only states where average to very much above average rainfall occurred over at least half of the surface area. Above average to very much above average rainfall occurred over more than 20 per cent of Queensland.

2.1.2 Climate drivers and distribution of rainfall

The Indian Ocean exerted a strong influence on Australia's climate during 2018–19. During spring 2018 and again in late autumn to winter 2019, a positive phase of the Indian Ocean Dipole (IOD) contributed to the dry conditions that persisted over much of Australia during the year. Even when the IOD value was neutral, the gradient of sea surface temperatures across the broader Indian Ocean (warmer in the west, compared to average in the east) tended to shift rainfall patterns away from Australia.

The tropical Pacific Ocean had less impact, with a warm-neutral phase of the El Niño–Southern Oscillation (ENSO) persisting through much of the year. El Niño like weather patterns, however, may have contributed to the drier than average wet season across northern Australia, where Darwin had its equal-third latest monsoon onset since 1957–58. Given that most of Australia's summer rainfall is attributed to the northern Australian wet season, the low rainfall across Australia during December 2018 to February 2019 (Figure 3) was largely influenced by the delayed monsoon onset.

While the IOD exerted a drying influence, a positive phase of the Southern Annular Mode (SAM) from late October 2018 to late December 2018 brought some rainfall relief to eastern mainland Australia during late spring and early summer as it directed more onshore conditions off the Tasman Sea and onto eastern Australia. A series of troughs brought above average rainfall to large areas of Western Australia in October and November. October and November 2018 were the only months of the 2018–19 year where Australia's rainfall was above average (Figure 3).

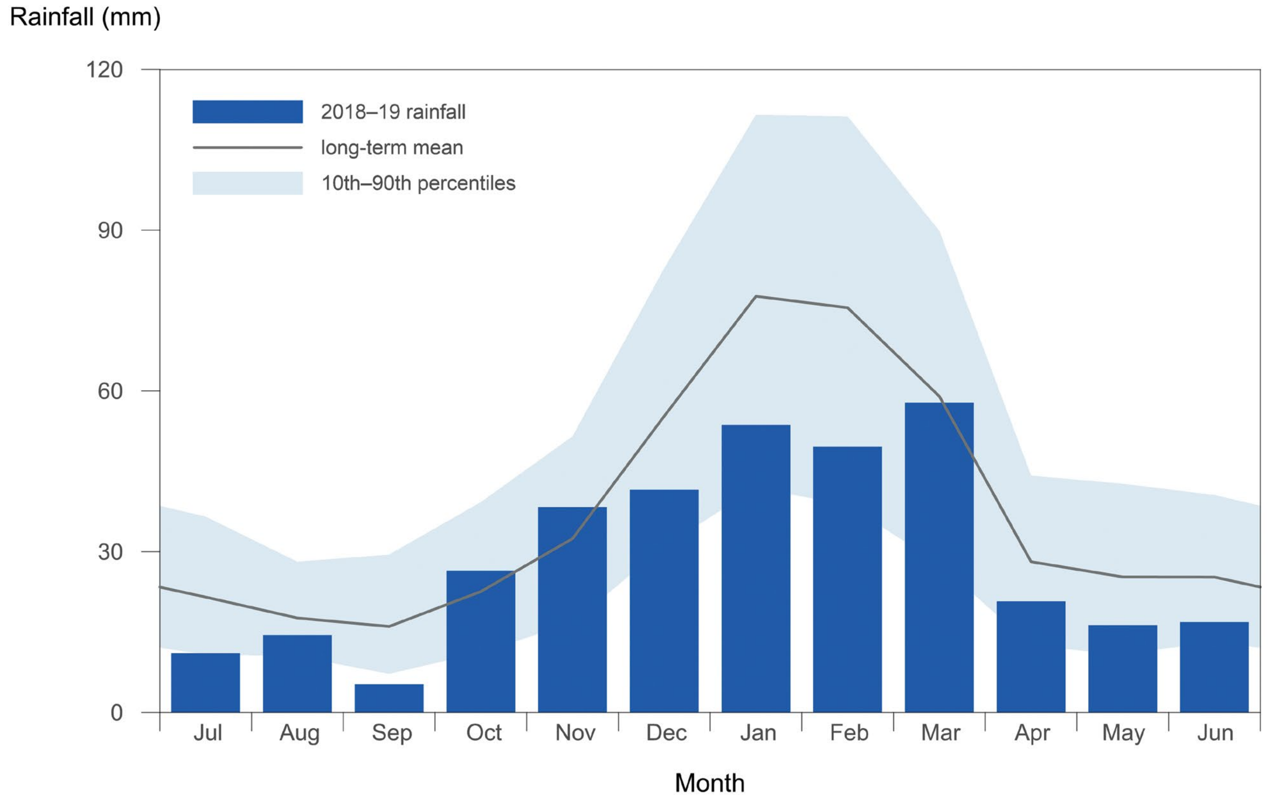


Figure 3. Australian monthly rainfall in 2018–19 compared with the average and the 10th to 90th percentiles (1911–2019)

The first three months of 2018-19 (July to September 2018) saw dry conditions over much of eastern Australia (Figure 4). Most of New South Wales, Queensland and Victoria recorded lower than average rainfall. Rainfall was very much below average over large winter cropping areas of Queensland, New South Wales, Victoria and South Australia resulting in strong early season demand for irrigation water. September was exceptionally dry across the southern mainland and nationally it was the driest September on record.

Rainfall was close to average across much of southern Australia in October and November 2018. Exceptions were a large area of southeastern Western Australia, which saw very much above average rainfall, and the western half of Tasmania, which had very much below average rainfall in October 2018. Areas of central and western southern-Australia saw very much above average rainfall in November 2018.

Rainfall for summer (December 2018 to February 2019) was below to very much below average for most of the country except for large parts of northern Queensland where the rainfall was higher than average. Tasmania recorded its second-driest January on record. This dry weather would have impacted on the summer cropping areas in Western Australia, New South Wales, South Australia, Victoria and Queensland.

The rainfall during the autumn months of April and May are critical for sowing and establishing of winter crops. Lower than average rainfall was observed for much of mainland southeastern Australia in April 2019 and over most of Western Australia in May 2019. Rainfall was higher than average for much of the Northern Territory and parts of coastal South Australia, Victoria, and inland southern New South Wales in May 2019.

The tropical north depends on rainfall during the wet season, which is usually from October through to April. The 2018–19 northern wet season was drier than average, except for Queensland. It was the fourth lowest rainfall on record (since 1911–12) for the Northern Territory.

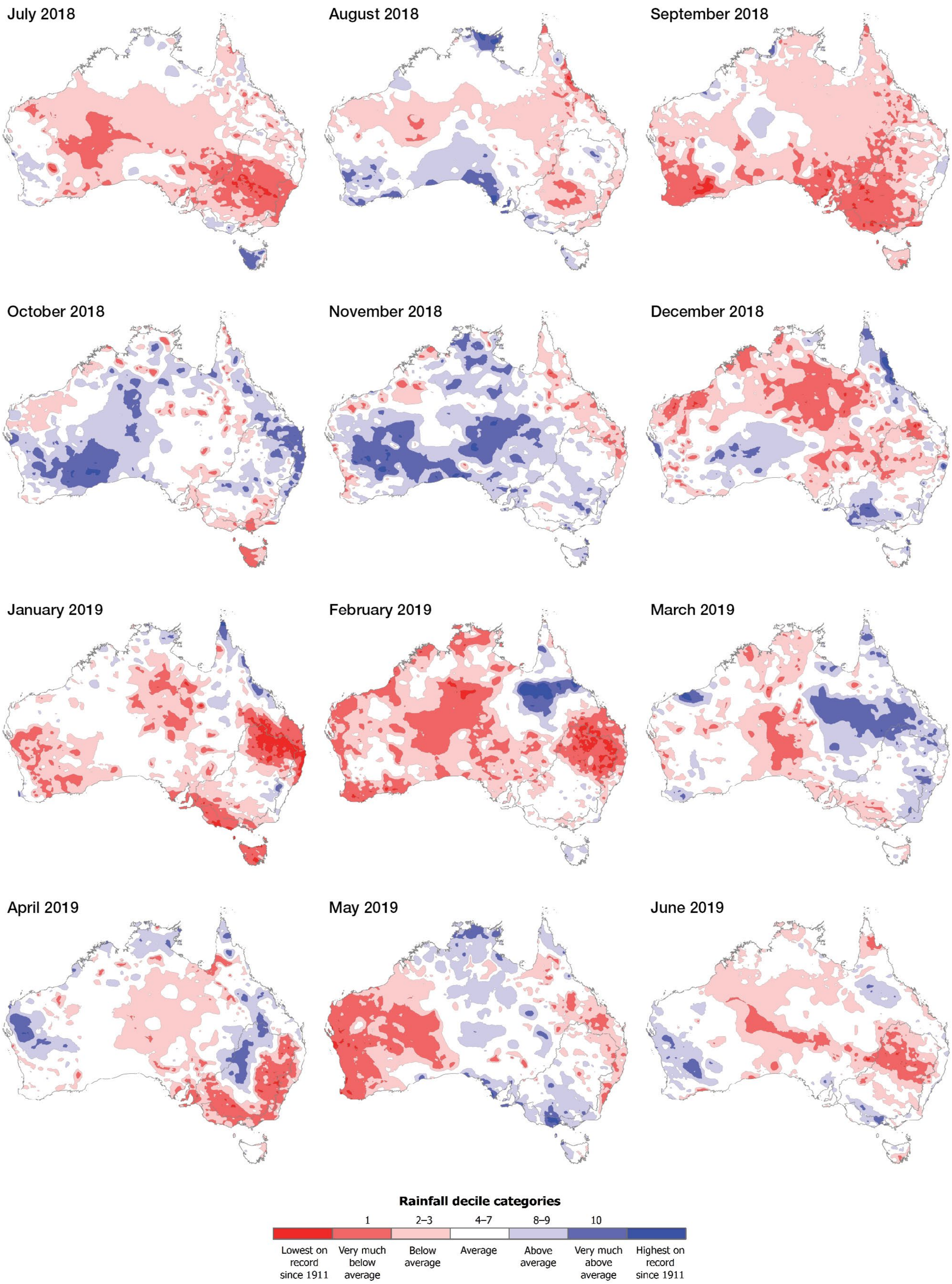


Figure 4. Monthly rainfall decile maps in 2018–19

2.1.3 Streamflow

The annual streamflow deciles for 2018–19 (Figure 5a) mostly followed the spatial distribution of the rainfall deciles (Figure 1). The differences between the percentages shown in the State and Territory decile charts for streamflow (Figure 5b) and rainfall (Figure 2) are largely due to the limited spatial distribution of the streamflow monitoring sites.

Lower than average flows were dominant over much of Australia (Figure 5a); 66 per cent of the streamflow gauges recorded lower than average annual flows. More than one quarter of all sites across New South Wales, the Australian Capital Territory and South Australia recorded their lowest annual streamflows on record (Figure 5b).

Throughout most of southeastern Australia, limited runoff due to low rainfall and poor soil moisture conditions resulted in very low streamflows. Lowest on record streamflows (since 1975) were observed on both the east and west sides of the Great Dividing Range. In the Darling River system, streamflows remained low from the top reaches to the confluence with the Murray River and the annual streamflow at Bourke was the lowest on record.

Below average wet season rainfall and low groundwater levels contributed to low flows in rivers across the northern parts of the Northern Territory and Western Australia. Streamflows in southwest Western Australia were around average due to near-average winter rainfall.

Higher than average flows were dominant in northern Queensland (Figure 5a). Annual streamflows in several rivers across the region were the highest on record. Heavy rainfall in early 2019 produced extensive flooding in Townsville, major flooding in the Burdekin River and high flows into Kati Thanda–Lake Eyre.

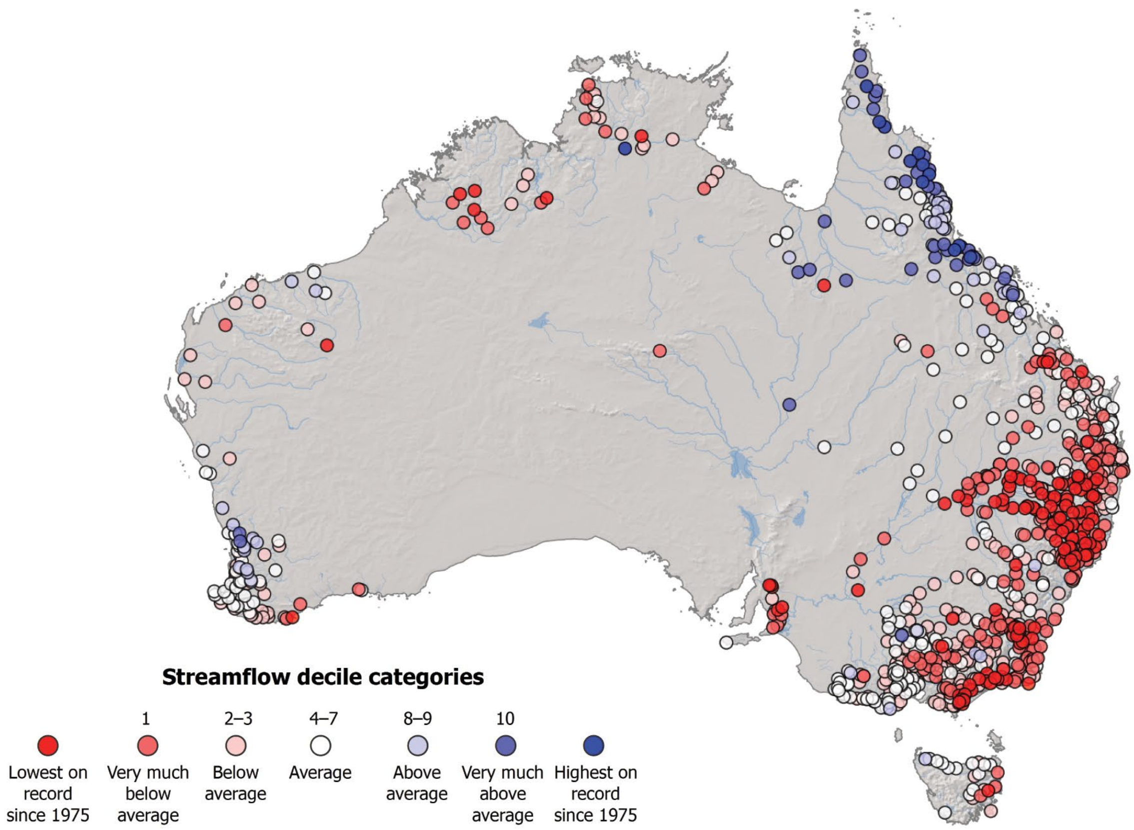


Figure 5. Streamflow deciles at long-term monitoring stations throughout Australia in 2018–19 (a) map

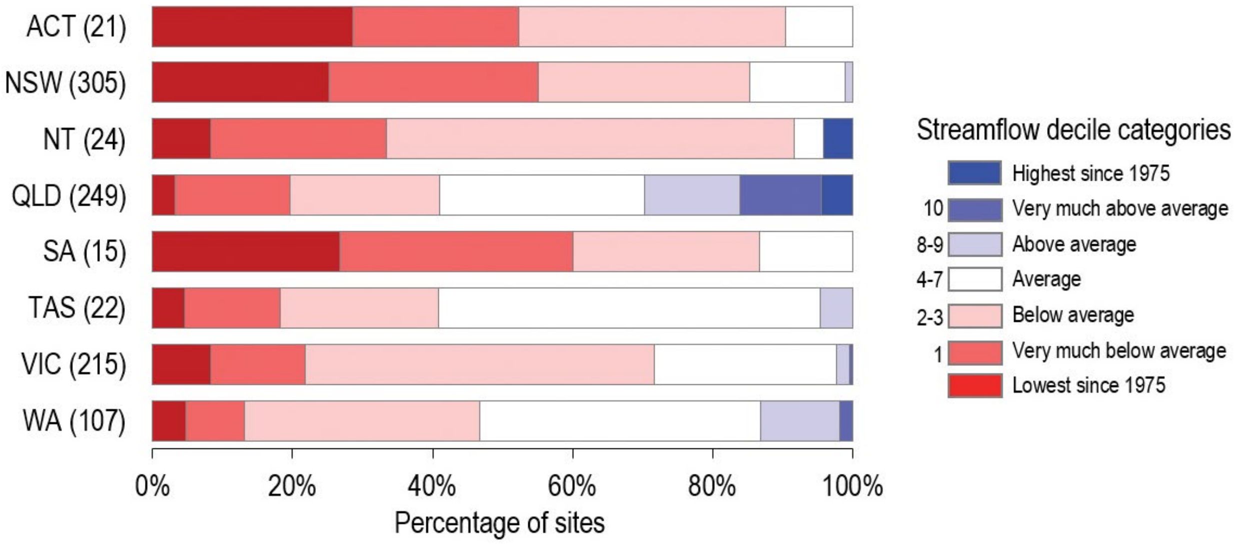


Figure 5. Streamflow deciles at long-term monitoring stations throughout Australia in 2018–19 (b) by number of gauges in each State or Territory

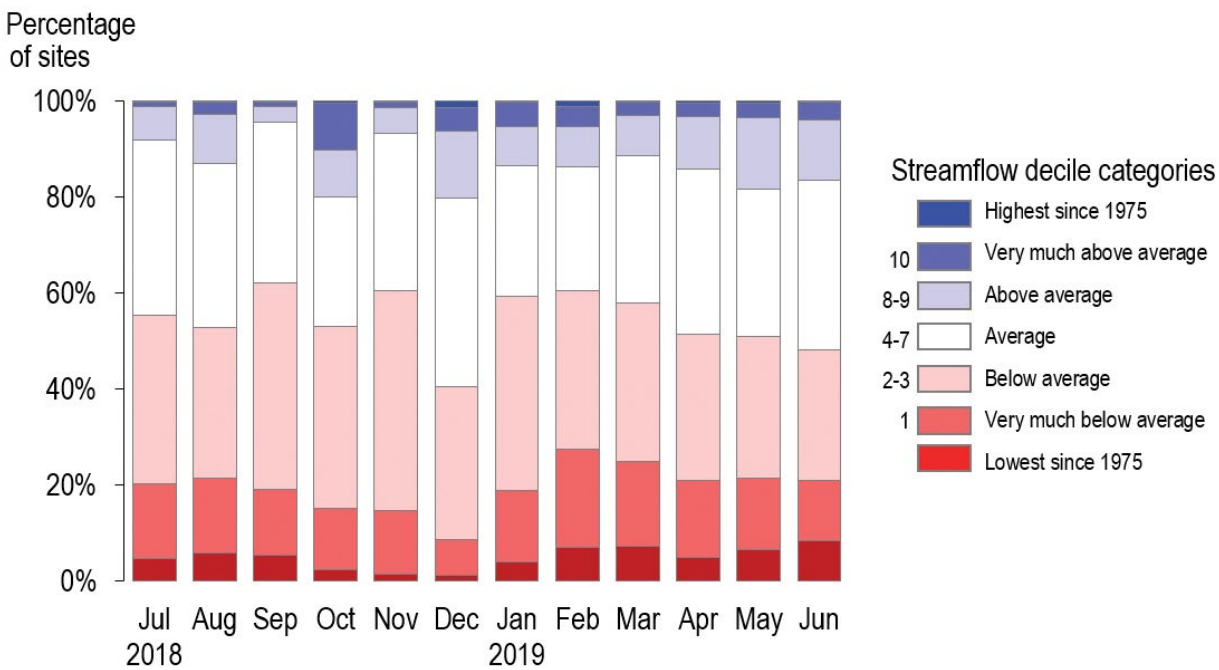


Figure 6. National monthly streamflow deciles

During almost every month of the year, more than 50 per cent of the streamflow gauges recorded lower than average monthly flows (Figure 6) reflecting the dry conditions across most of Australia throughout the year. December 2018 was the only month where most sites recorded average or higher flows. This was due to a combination of higher than average rainfall across the eastern mainland of Australia during late spring and early summer, as well as heavy rainfall associated with tropical cyclones *Owen* (15 December 2018) and *Penny* (1 January), which impacted the east coast of Queensland.

With the low rainfall over much of eastern Australia during the first three months of 2018–19 (July to September 2018), most of New South Wales, Queensland and Victoria recorded lower than average streamflows (Figure 7). This resulted in a strong demand for irrigation water for winter cropping early in the season. Lower than average flows predominated in more than 60 per cent of the streamflow gauges across the country in September. Higher than average flows dominated in the southwest coast in August 2018 due to the higher than average rainfall in that area.

Despite the above average rainfall in much of southeastern Western Australia during October to December 2018, it did not produce substantial flows at the stream gauging locations due to dry antecedent conditions in the vicinity of the sparsely distributed gauges (Figure 7). Higher than average flows were recorded at the gauges along the east coast of New South Wales and Queensland in October due to higher than average rainfall.

Record low flows in the lower Darling during December 2018 and January 2019 contributed to fish deaths along a 40 km stretch of the river downstream of the Menindee Lakes (Figure 7).

Dry conditions continued in southern Australia in early 2019 with more than 60 per cent of the gauges recording lower than average flows in January and February 2019 (Figure 7). As a consequence, demand for irrigation water for summer crops increased in the Murray–Darling Basin. By the end of the summer season (February 2019), storages in the Murray Darling Basin had fallen to 32 per cent of capacity (compared to 52 percent in July 2018) due to reduced inflows and increased releases for agricultural use.

The 2018–19 northern wet season was drier than average, except for Queensland, and most of the sites in the northern parts of the Northern Territory and Western Australia recorded lower than average flows from December to April (Figure 7). However, several of the gauges in northern Queensland received their highest on record flows in December 2018 and February 2019. The highest on record flows in December 2018 were as a result of the heavy rainfall that occurred due to the severe tropical cyclone *Owen*. Very much above average rainfall in the region in late January and early February, arising from an intense monsoon low, resulted in highest on record flows in February.

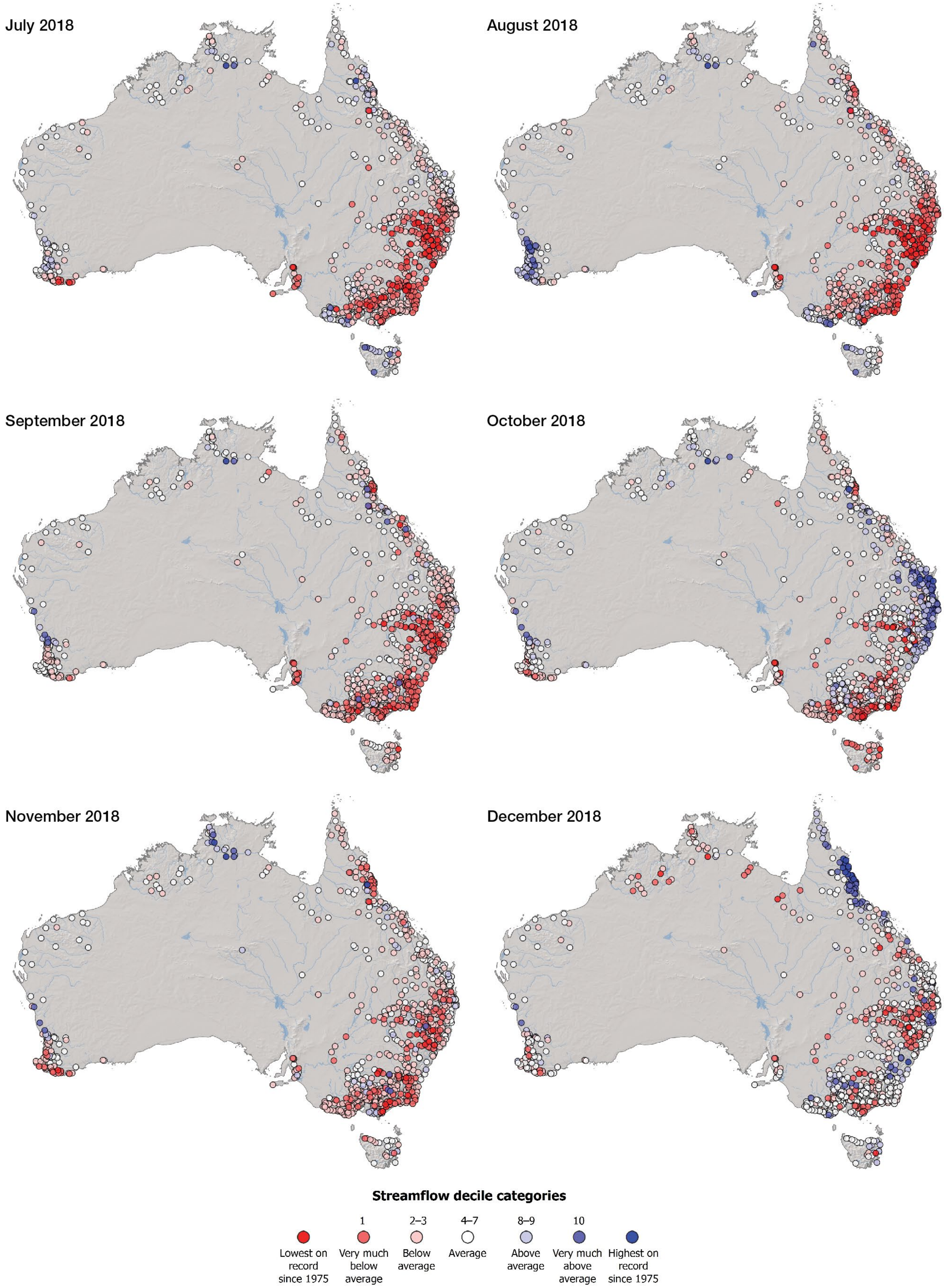


Figure 7. National maps of monthly streamflow deciles in 2018–19

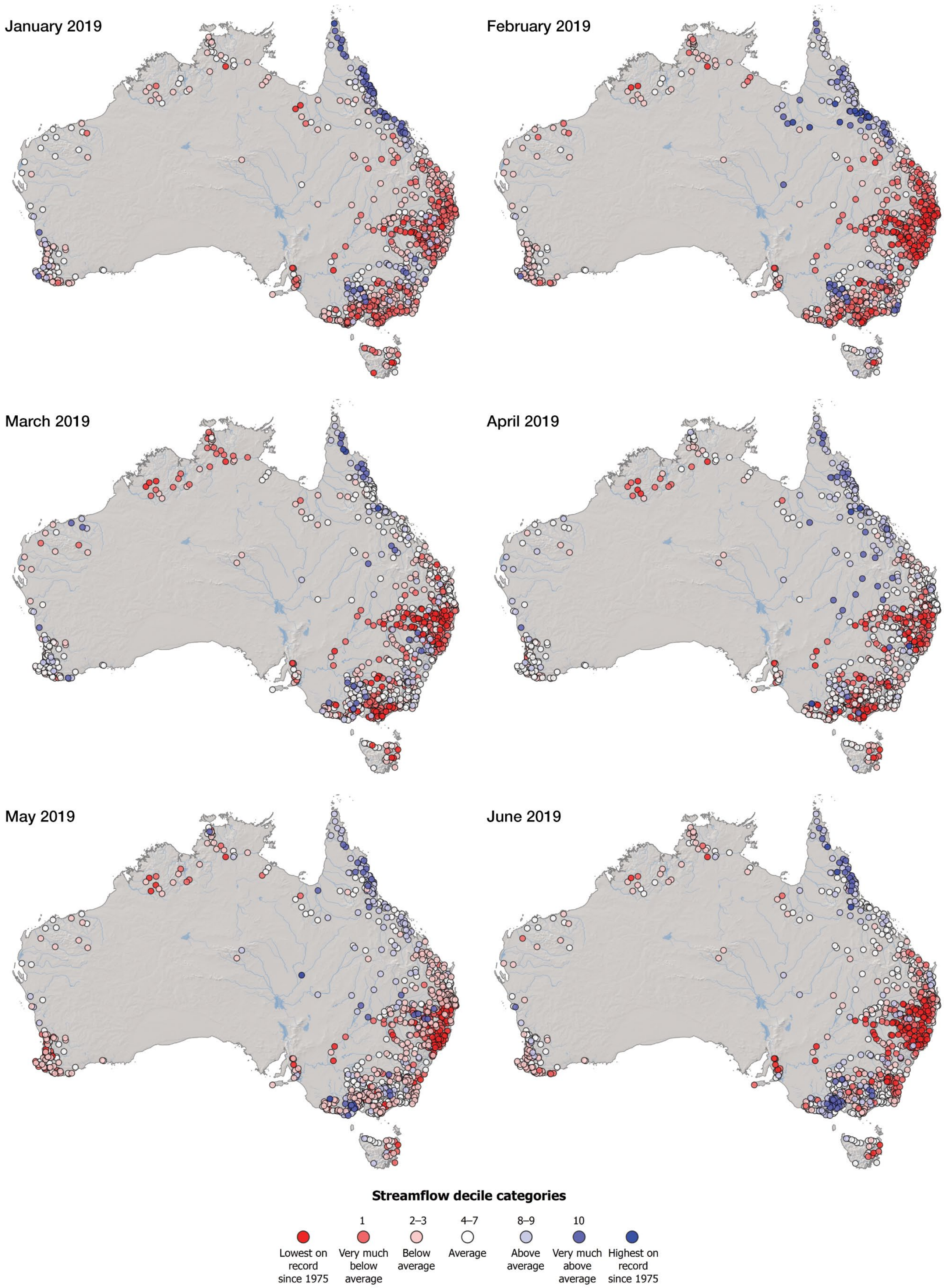


Figure 7. (continued) National maps of monthly streamflow deciles in 2018–19

2.2 WATER STORAGES

2.2.1 National view

Australia has over 500 major storages, several thousand small storages and in excess of two million farm dams. Large storages are essential for coping with the highly variable rainfall and high temperatures that are prevalent in much of Australia. The total accessible storage capacity is about 81 000 GL (Bureau of Meteorology, 2018), which is equivalent to a relatively high national per capita surface water storage capacity of about 3.25 ML.

Tasmania has 54 large storages primarily to provide water for hydro-electric power generation. On the mainland, storages are concentrated mainly in the southeast where the largest irrigation areas and most of the major urban centres are located. Here, water is mostly used for direct water supply, including agricultural, urban and industrial uses, as well as for environmental releases.

The combined accessible storage capacity of major storages for direct water supply purposes across Australia at the beginning of 2018–19 was 50 500 GL. The combined accessible storage volume at the start of the year was 31 836 GL, or 63 per cent of capacity. Due to dry conditions throughout much of Australia and continued diversions from these storages, the accessible storage volume decreased to 46 per cent of capacity by the end of 2018–19. This is the second successive drop in annual storage across Australia and the lowest volume in more than 10 years (Figure 8).

After the end of the Millennium Drought (mid-2010) the combined accessible storage volume reached full capacity in April 2011. The storage volume then slowly dropped to 52 per cent of capacity in May 2016 and then rose to 86 per cent capacity in March 2017 due to the wet weather throughout much of Australia during 2016–17. It then gradually dropped to its lowest volume in more than 10 years at the end of 2018–19.

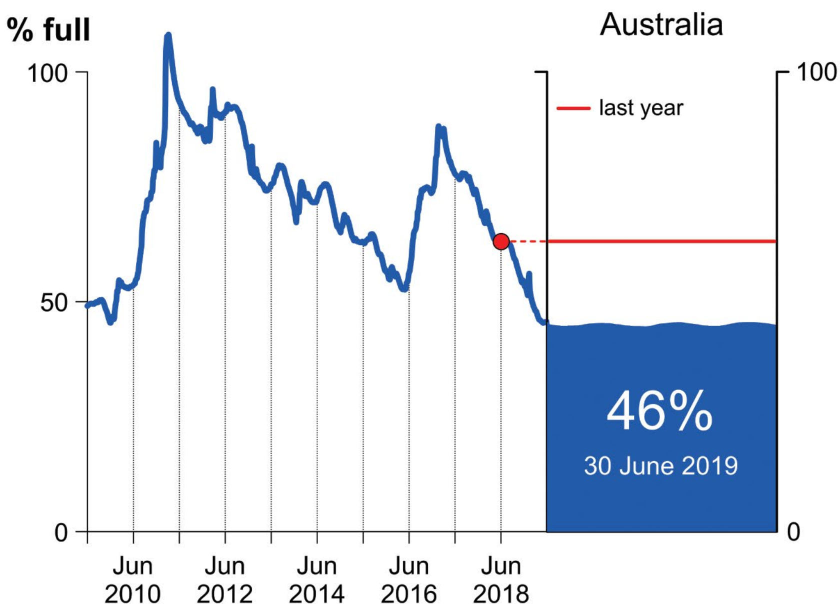


Figure 8. Time series of storage volume as a percentage of capacity for combined urban and rural storages

2.2.2 Urban storages

At the start of the 2018–19 year, the combined accessible water volume in urban storages across Australia was 7006 GL (70 per cent of capacity), decreasing to 5836 GL (58 per cent of capacity) by the end of the year (Figure 9). The combined accessible storage volume of urban storages showed a steady decline throughout the financial year and the end of 2018–19 was at its lowest volume since the end of the Millennium Drought.

Below average rainfall and low runoff across southeastern Australia led to decreased storage volumes in almost all the urban supply systems along the southeast coast, including the supply systems for the major urban centres of Brisbane, Sydney and Melbourne (Figure 10). The storage volumes in Brisbane and Sydney declined for most of the year and by the end of 2018–19, were at their lowest levels in more than 10 years (Figure 11).

In January 2019, Sydney's total accessible storage capacity dropped below 60 per cent and the desalination plant commenced operation for the first time since 2012. By June 2019, the accessible storage volume dropped to 52 per cent, prompting the introduction of temporary level 1 water restrictions. This meant residents and businesses were not allowed to leave hoses running unattended, wash vehicles and buildings with a hose that was not fitted with a trigger nozzle or use standard sprinklers and watering systems.[4]

4 https://www.sydneywater.com.au/SW/water-the-environment/what-we-re-doing/water-restrictions/index.htm

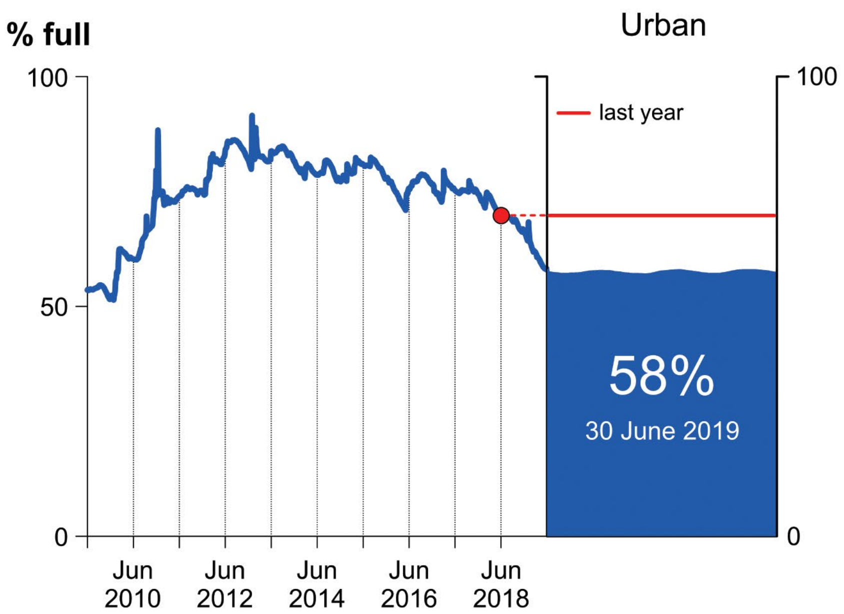


Figure 9. Time series of storage volume as a percentage of capacity for combined urban storages

In Perth, the storage volume of the system increased for the third consecutive year (from 37 per cent at 30 June 2018 to 41 per cent at 30 June 2019) and was the highest since July 2010 (Figure 11). The increase in 2018–19 was influenced by high storage inflows following a wet winter in 2018.

In Adelaide, despite below average rainfall for most of the year, storage volumes at the end of 2018–19 were similar to those at the start of the year, largely due to high rainfall across the region during May 2019.

Storage volumes of the urban supply systems across northern and central Queensland were at least 90 per cent of capacity at the end of 2018–19, reflecting the high rainfall and flooding throughout the region in early 2019.

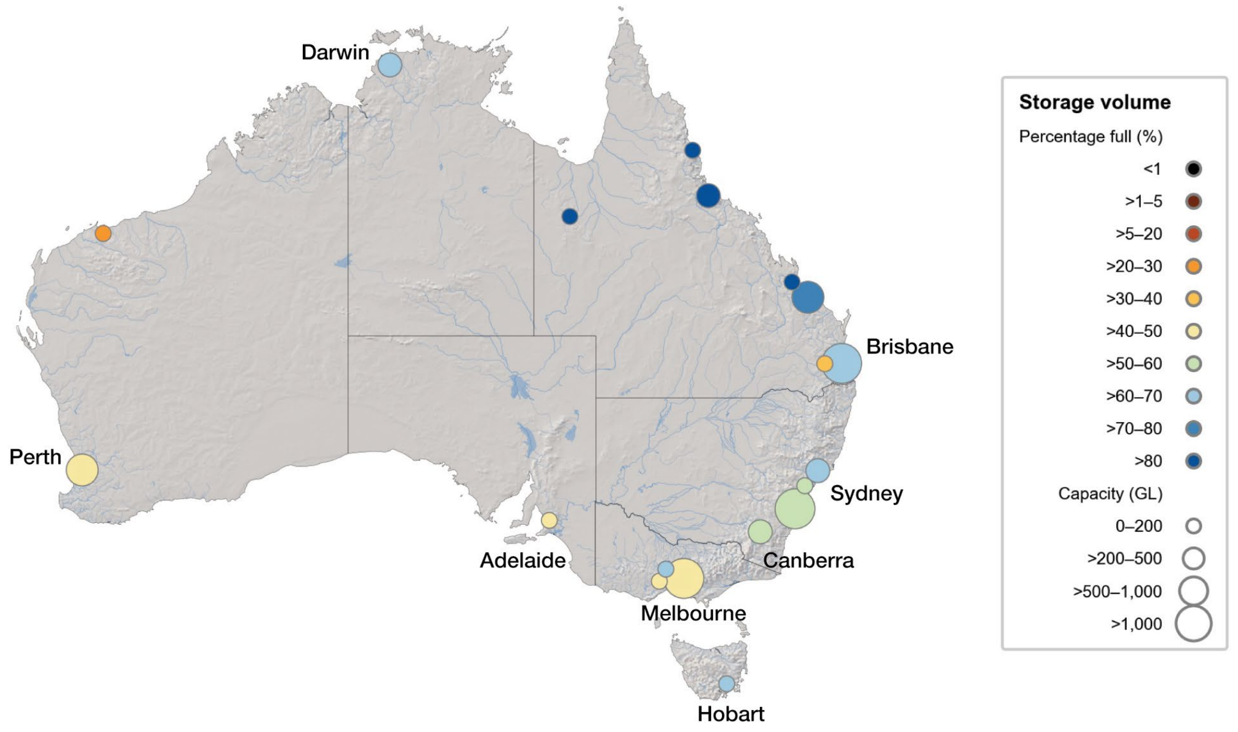
The normal filling and spilling of the Darwin River storage did not occur due to the limited rainfall across northwestern Australia. Except for small increases in storage during January–February 2019, the storage volume declined for most of the year.

The combined accessible storage volumes dropped in Adelaide, Canberra, Melbourne, South East Queensland (SEQ) and Sydney in comparison to the previous year due to lower than average rainfall across southeastern Australia (Figure 11). The storage volumes in the Canberra, South East Queensland and Sydney systems dropped steadily for almost the entire year. The Sydney system experienced a steep decline during the previous few years from a near full storage volume in April 2017, whereas the Canberra system declined from a full storage volume in October 2016.

The accessible storage volume of the Hobart system (Risdon Brook storage) was close to full capacity during the previous decade. Below average streamflow and water use resulted in a decline in accessible storage volumes from October 2018 to a low of 57 per cent of capacity in June 2019, the lowest level in more than 10 years (Figure 11). The end of year storage volumes in South East Queensland and Sydney were the lowest since July 2010 and for Canberra and Melbourne they were the lowest since July 2011.

Darwin receives the most seasonally variable rainfall among all capital cities and the storage volume generally peak towards the end of the wet season (October to April). Since 2011, the storage volume has been more than 90 per cent of capacity in every March–April except in 2012–13 and 2018–19 when it was below 70 per cent full (Figure 11).

(a) At 30 June 2019



(b) Change from 30 June 2018

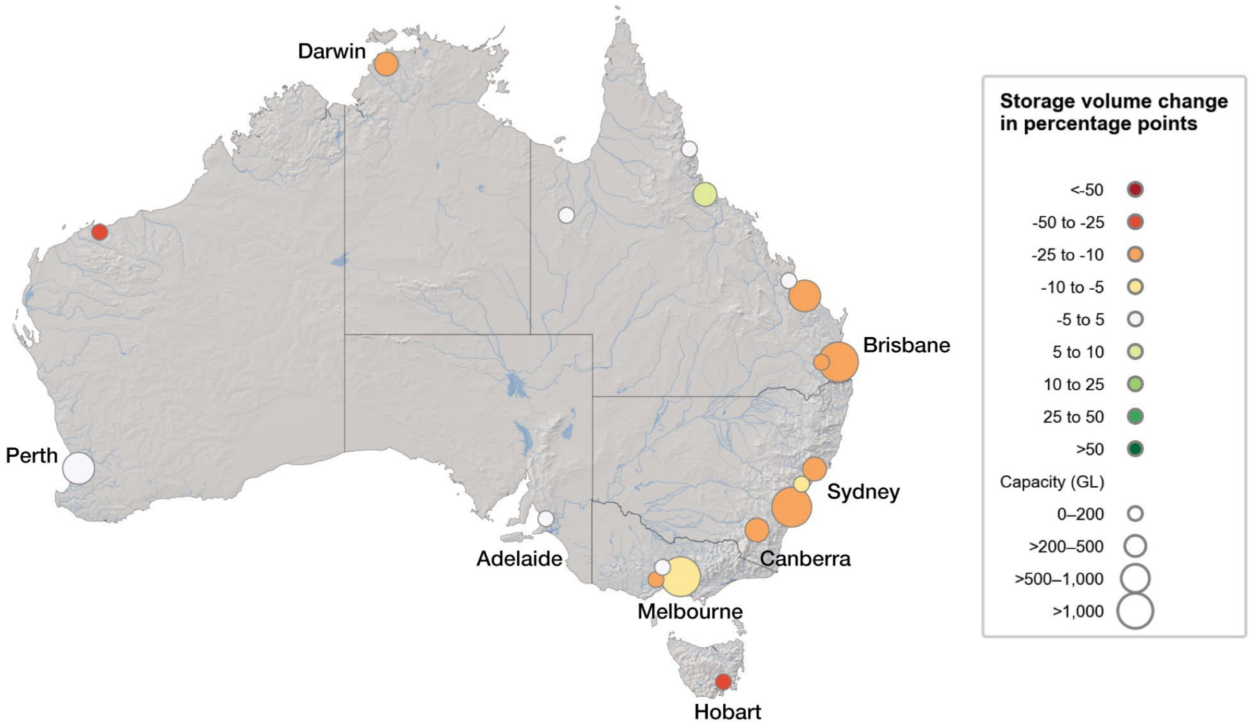


Figure 10. The distribution and status of urban storage systems (a) At 30 June 2019 (b) Change from 30 June 2018

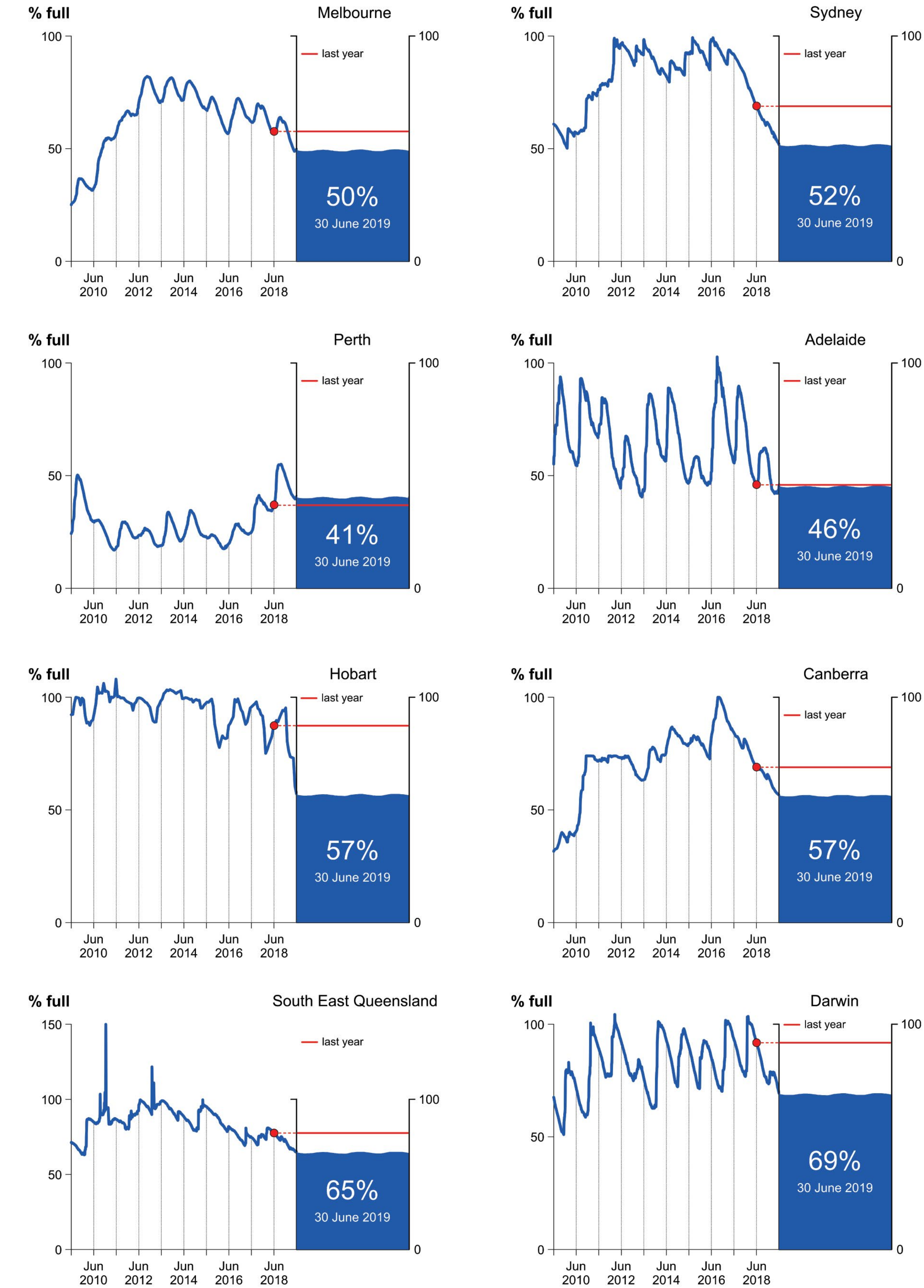


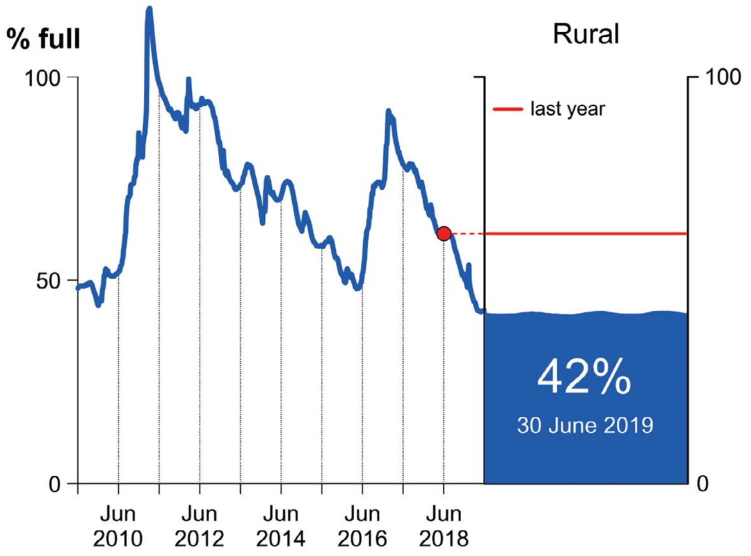
Figure 11. Time series of storage volume as a percentage of capacity for urban storages

2.2.3 Rural storages

At the start of the 2018–19 year, the combined accessible water volume in rural storages across Australia was 24 830 GL (60 per cent of capacity), decreasing to 17 380 GL (42 per cent of capacity) by the end of the year (Figure 12a). Most of Australia's major rural storage systems are located within the Murray–Darling Basin. The combined accessible storage volume of rural storages across Australia showed a decline throughout most of the year and at the end of 2018–19 storages were the lowest for the last ten years. Combined accessible storage volume was previously above capacity in June 2011 immediately after the end of the Millennium Drought.

In the Murray–Darling Basin the accessible storage volume dropped from 51 per cent at the start of the year to 30 per cent at the end of June 2019. The accessible storage volume was the lowest since June 2016 (Figure 12b). Below average rainfall and low runoff across southeastern Australia led to decreased storage volumes in almost all the supply systems within the Murray–Darling Basin (Figure 13). In the northern part of the Murray–Darling Basin, accessible storage volumes in several supply systems were less than 10 per cent of capacity by the end of 2018–19 and at their lowest levels in more than 10 years.

(a) Combined rural water storage



(b) Murray–Darling Basin water storage

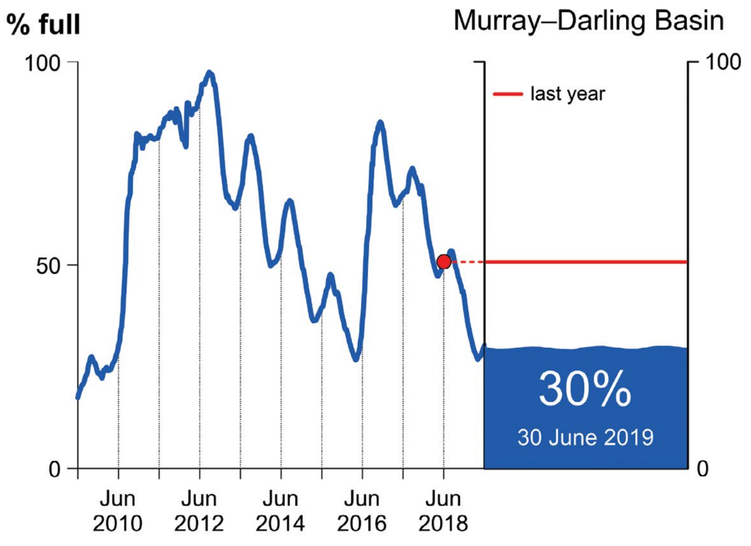
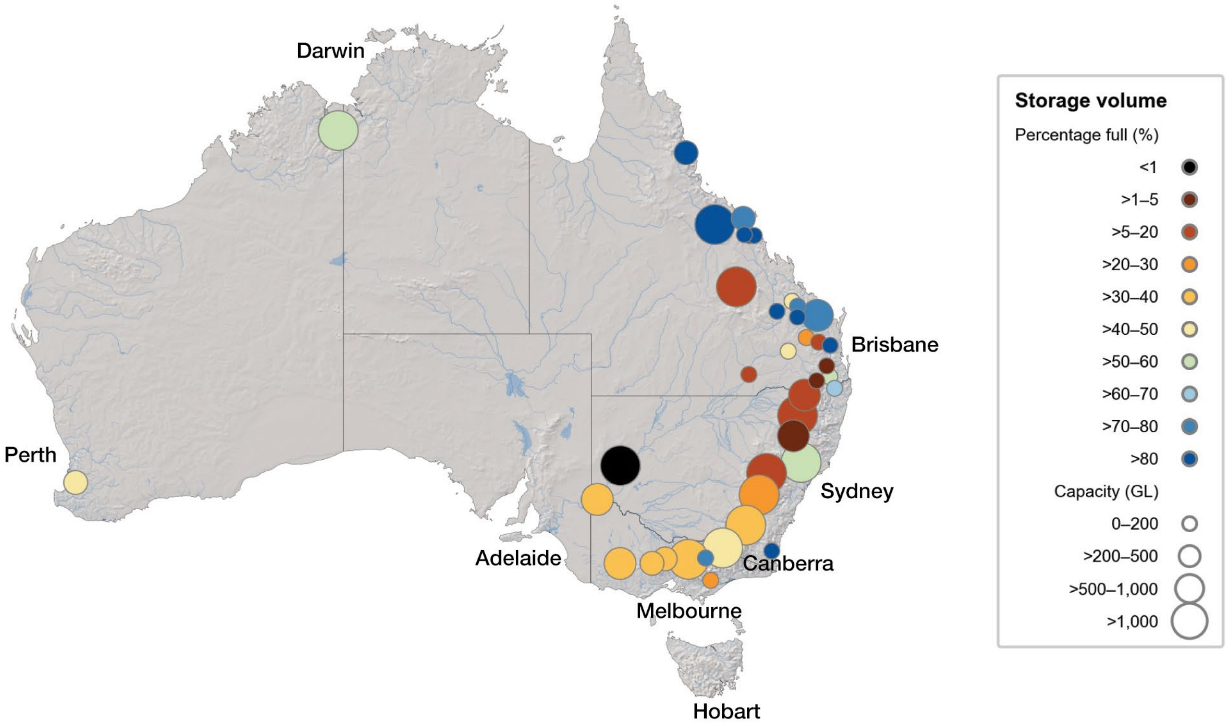


Figure 12. Time series of storage volume as a percentage of capacity for (a) Combined rural storages and the (b) Murray–Darling Basin

(a) 30 June 2019



(b) Change from 30 June 2018

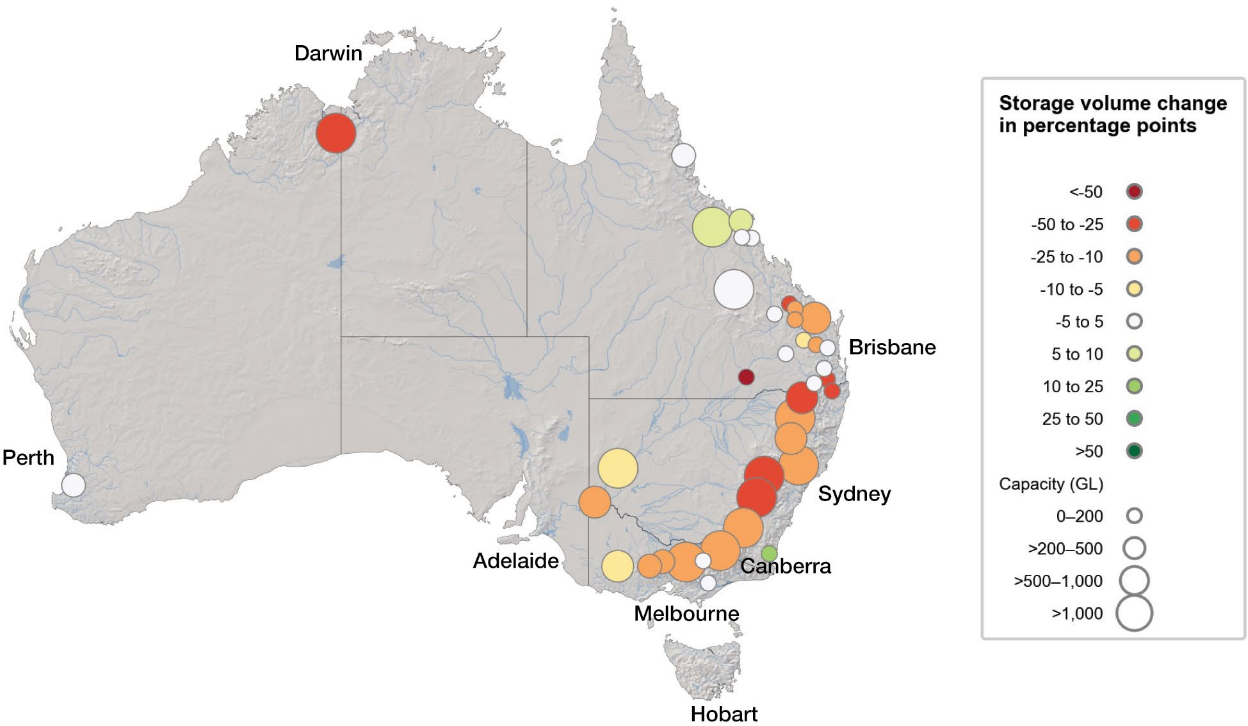


Figure 13. The distribution and storage status of rural storage systems (a) 30 June 2019 (b) Change from 30 June 2018

In contrast, storage volumes of the rural supply systems across northern Queensland were above 80 per cent of capacity at the end of 2018–19, reflecting the high rainfall and flooding throughout the region in early 2019 and their smaller storage capacity relative to streamflow.

In the Ord region, the normal filling and spilling of the storages did not occur for the second successive year due to below average wet season rainfall in the upper catchment areas. Accessible storage volume in Lake Argyle, one of Australia's larger reservoirs, was 52 per cent of capacity at the end of 2018–19, the lowest end-of-year storage volume in more than 10 years.

In the Collie–Harvey–Waroona system, which supplies water to Western Australia's Harvey Water Irrigation Scheme, storage volumes increased for the second consecutive year. The increase in 2018–19 was influenced by high storage inflows following a very wet winter in 2018.

2.2.4 National Water Account storages

The National Water Account (NWA) [5] provides a picture of water resources management for the reporting year for eleven nationally significant water use regions which includes five rural and six urban regions (Figure 14).

The reporting regions included in the NWA are home to more than 75 per cent of Australia's population and are where 70-80 per cent of Australia's total annual water consumption occurs. This section summarises the storages information available from the eleven NWA reports.

Storage volumes in the Ord and Fitzroy regions declined for almost the entire year for the second successive year. At 30 June 2019, Ord and Fitzroy storages were at their lowest end-of-year levels in more than 10 years. Storage volumes in the Fitzroy region decreased from 36 per cent full at 30 June 2018 to 29 per cent full at 30 June 2019. Storage volumes in the Burdekin storages increased from 93 per cent full at 30 June 2018 to 99 per cent full at 30 June 2019 (Figure 15). In the Murray–Darling region the accessible storage volume dropped from 49 per cent to 29 per cent due to very much below average rainfall. Accessible volumes in most storages in the Murray–Darling Basin were lower at the end of the year.

In the urban regions end of year storage volumes increased in Perth and decreased in Adelaide, Melbourne, Canberra, Sydney and South East Queensland.

5 www.bom.gov.au/water/nwa/2019/

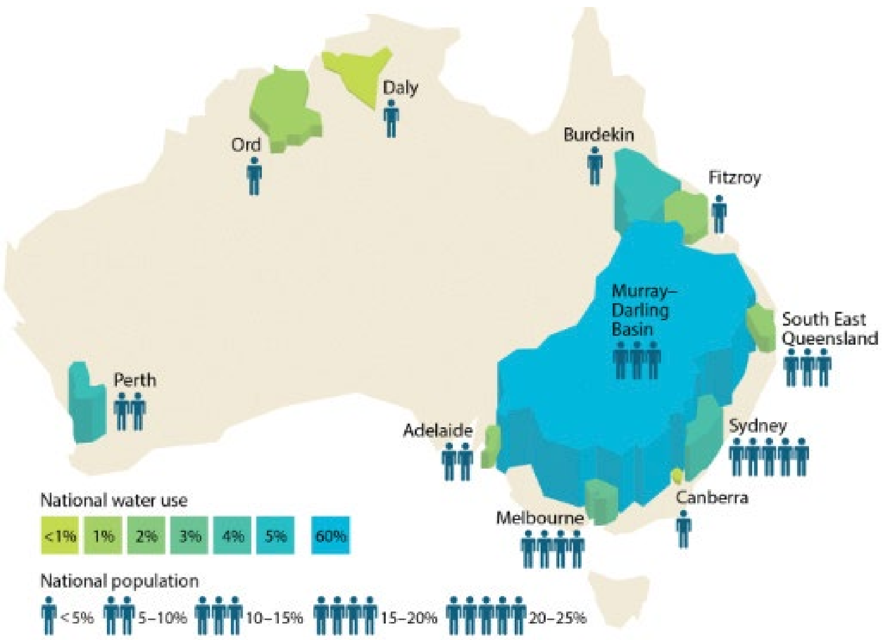
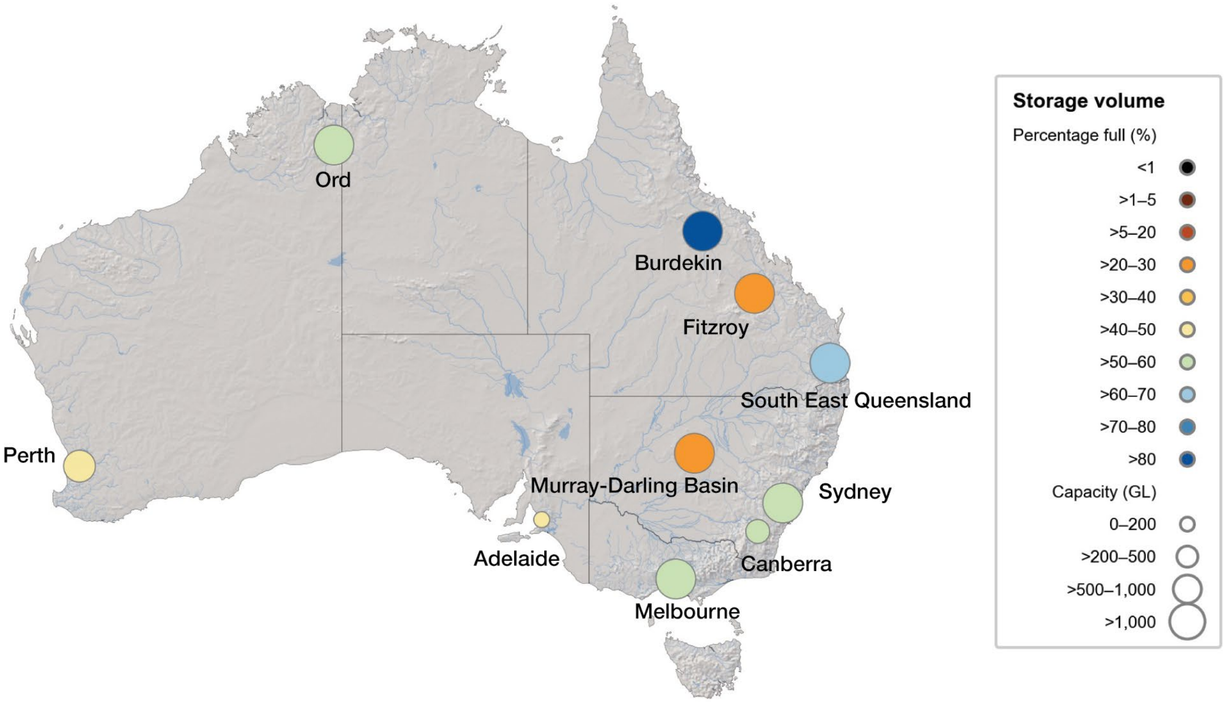


Figure 14. National Water Account regions

(a) 30 June 2019



(b) Change from 30 June 2018

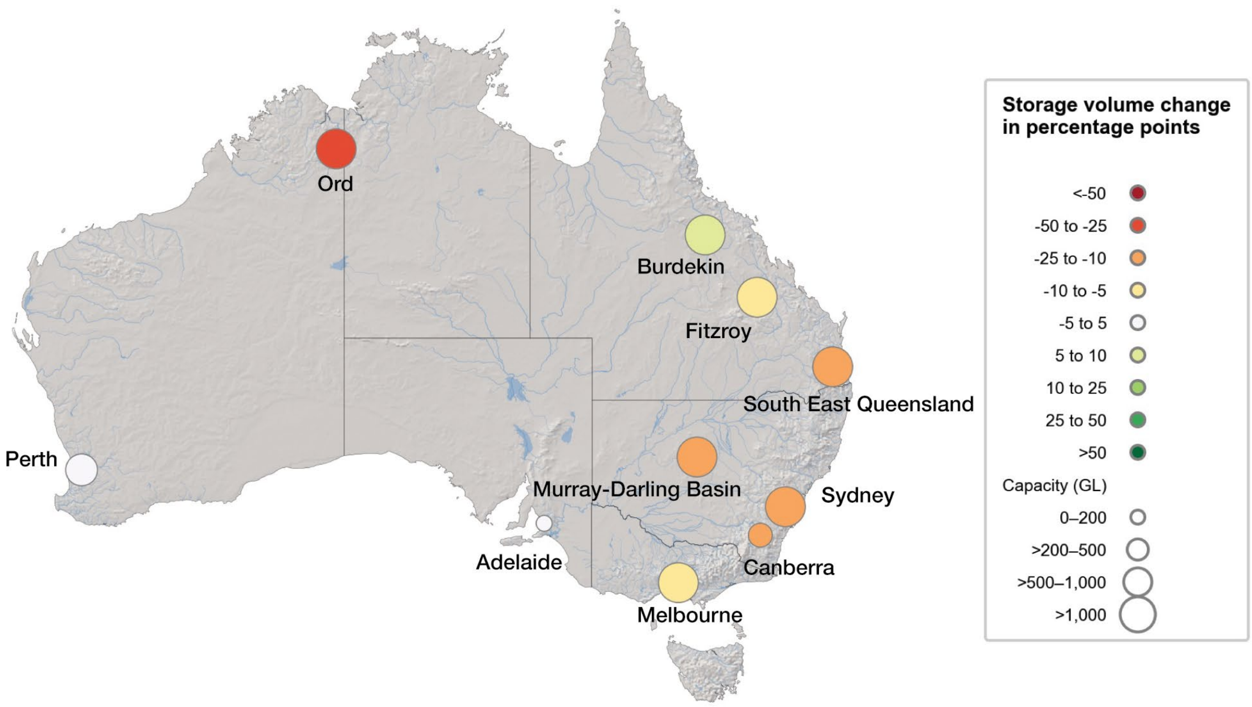


Figure 15. The distribution and storage status of NWA storage systems (a) 30 June 2019 (b) Change from 30 June 2018

2.3 STREAMFLOW SALINITY

In many parts of Australia, soils, surface water and groundwater have a high salt content due to the dry climate and highly weathered landscape. For example, Western Australian streams are naturally more saline than streams in northern Australia and along the eastern divide, where greater rainfall dilutes salt concentrations.

Across Australia, dryland and irrigated agriculture and clearing of native, perennial vegetation have changed the catchment water balance. These changes in landscapes increase the mobilisation of highly soluble salts from saline aquifers or shallow water tables into streams. This unnatural increase in salinity can present a risk to aquatic ecosystems and vegetation health (Lake, 2003).

Within the Murray–Darling Basin and in several other areas in Australia, salinity is increasingly managed and monitored through the implementation of jurisdictional Land and Water Management Plans that include water quality. These plans can provide a framework for setting salinity objectives and targets, as well as for developing on-ground measures to improve salinity conditions. Such measures include provision of adequate water flows, investing in re-vegetation, improving irrigation and dryland farming practices, and salt interception schemes that minimise the movement of salts.

To support water quality management and planning, an Australian Government initiative has created the Water Quality Australia website in partnership with State and Territory governments.[6] The website provides tools and resources to guide water managers, researchers, industry and State, Territory and local governments in developing and implementing water quality plans and strategies.

6 www.waterquality.gov.au

2.3.1 Median streamflow salinity

Stream salinity concentrations determine the suitability of water for various uses; for example, drinking and irrigation. They can also be an indication of impacts on ecosystems. The broad salinity categories for which water is considered fit for various uses are provided in Table 1.

In 2018–19, 73 per cent of Australia's river and stream sites were on average fresh and suitable for drinking while 9 per cent of sites were marginal. The remaining 18 per cent of the sites were *brackish* or *saline*.

The sites with fresh median water salinities were mostly located in areas with high rainfall, along the east coast (Figure 16). Eighty-four per cent of the 159 sites in New South Wales and 93 per cent of the 72 sites in Queensland had fresh median water salinities. In the Murray–Darling Basin, median streamflow salinities were mostly fresh; however, salinities tended to be higher in the lower reaches of the River Murray.

In contrast, streams in Western Australia had higher water salinities. Almost three quarters of the sites in Western Australia were brackish or saline. In South Australia about a quarter of the sites were brackish or saline.

Table 1. Water salinity and primary suitability for use

Salinity category	TDS concentration (mg/L)	Suitability for use
Fresh [7]	0–500	Good-quality water suitable for drinking and all irrigation
Marginal	500–1 000	Fair- to poor-quality drinking water; most irrigation; adverse effects on ecosystems may become apparent
Brackish	1 000–3 000	Unacceptable-quality drinking water; useful for most livestock; irrigation limited to certain crops
Saline	3 000–35 000	Unacceptable drinking water quality: use may be limited for certain livestock
Hyper-saline	>35 000	Seawater salinity or greater, undrinkable, some mining and industrial uses

mg/L = milligrams per litre; TDS = total dissolved solids

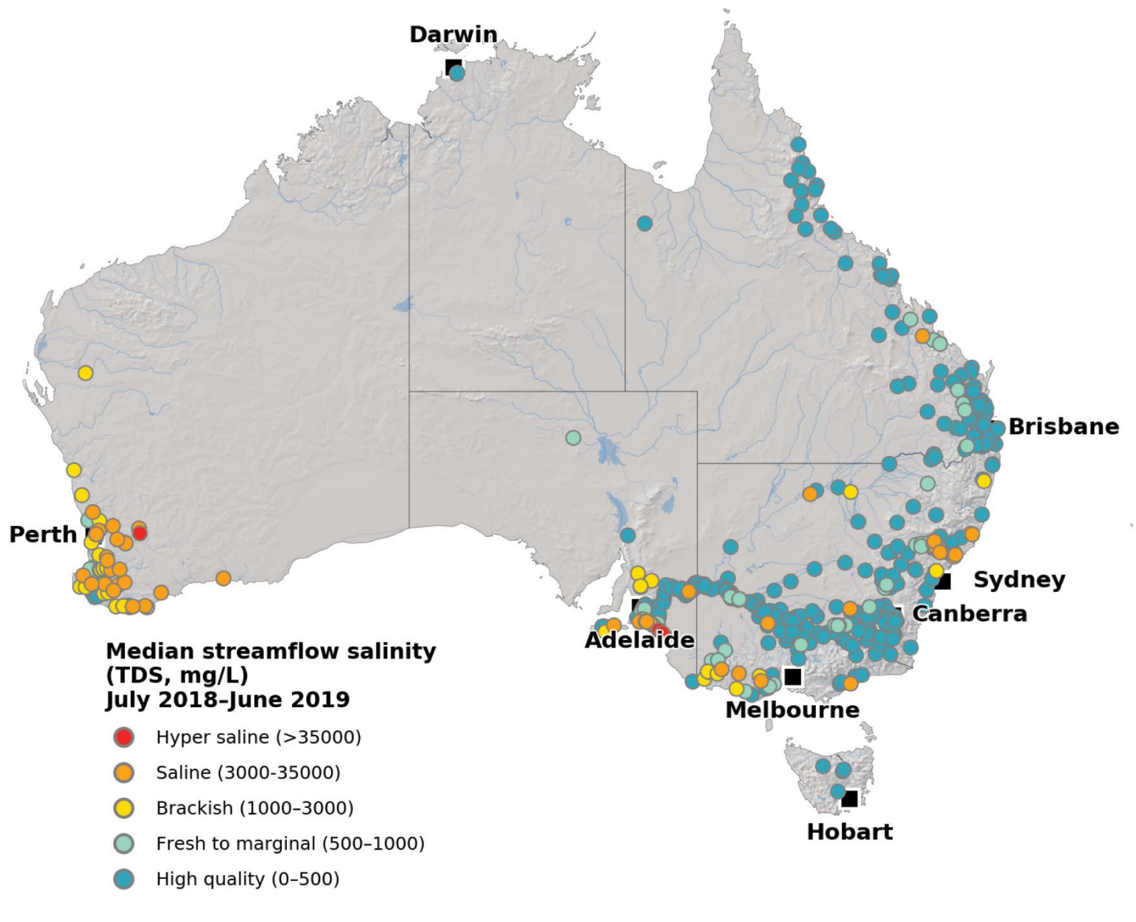


Figure 16. Distribution of median annual streamflow salinity across Australia in 2018–19

7 The Australian Drinking Water Guidelines – Updated August 2018 refer to a threshold of 600 mg/L TDS as good quality drinking water (https://www.nhmrc.gov.au/about-us/publications/australian-drinking-water-guidelines)

2.3.2 Changes in median streamflow salinity

At individual sites, streamflow salinity typically changes over time due to complex flow and salinity dynamics. Data used for the comparison were from 457 gauging stations that had reliable data for 2017–18 and 2018–19.

With less water available in 2018–19, streamflow salinity increased within the rainfall-deficient areas, particularly across southeastern Australia. Around 56 per cent of the 457 gauging sites had an increase in median streamflow salinity. An increase of more than 500 mg/L TDS was observed at only four per cent of the monitoring sites and an increase of up to 100 mg/L TDS was observed for 46 per cent of monitoring sites.

A decrease in stream salinity of more than 500 mg/L TDS was observed at only 8 per cent of the monitoring sites. Most of these larger decreases occurred in Western Australia (Figure 17), reflecting the increased water availability following a wet winter in this region.

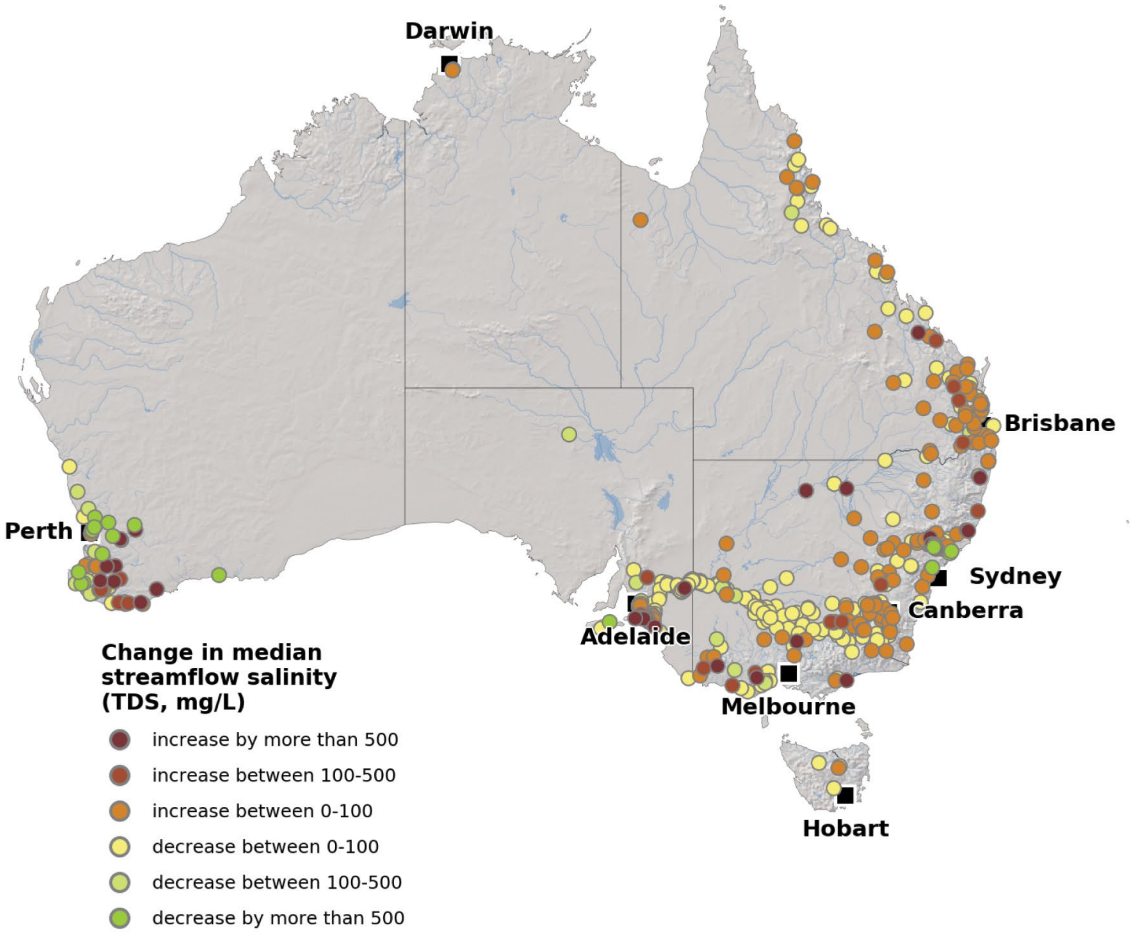


Figure 17. Changes in median streamflow salinity from 2017–18 to 2018–19

2.4 GROUNDWATER

2.4.1 Overview

In many regions across Australia, groundwater is the only reliable water source. Numerous towns, farms and mines, particularly in the outback, rely almost completely on groundwater. Depending on the annual climatic conditions, one-fifth to one-third of the annual water used in Australia comes from groundwater. The sustainability of groundwater use is subject to the pressures of climatic conditions and extractions. Recharge rates are typically very small compared to the volumes in the aquifer. Also, groundwater is often saline, which reduces its suitability for use. Over time, water from rain and rivers travels through the ground and collects in underground rock fractures or between grains of sediment. The layering and structure of aquifers and aquitards makes up the groundwater system and dictates how water flows below the ground and interacts with rivers, wetlands and vegetation at the surface. The groundwater analysis presented here is a simplified representation of the three-dimensional groundwater systems across Australia—they are aggregated into upper, middle and lower groups, as presented in Australian Groundwater Insight.[8]

2.4.2 Groundwater levels

Groundwater levels measured from bores are one of the few direct measurements available to understand changing groundwater conditions. Groundwater typically responds slowly to direct climatic changes, especially in comparison to surface water. This report uses groundwater level status and a five-year trend to assess changes in groundwater levels in 2018–19. Examining trend and status data together is a useful way to give context to year-to-year changes.

The groundwater level recovery peak is defined as the maximum groundwater level observed in a bore during the year. Recovery peaks occur through natural groundwater recharge and/or pressure recovery in the non-pumping season. The groundwater level status for a bore is a decile ranking of the recovery peak for 2018–19 against the bore's average annual recovery peak (based on data from 1997–2019) [9]. The five-year trend in annual recovery peaks (from July 2014 to June 2019) indicates whether groundwater levels at a bore are rising, stable or declining. Figure 18 shows the distribution of groundwater level status and Figure 19 shows the distribution of groundwater level trends at bores across Australia for (a) upper (b) middle and (c) lower aquifer groups.

Lower than average groundwater levels were dominant over much of Australia in all aquifer groups (Figure 18). Almost two thirds of the upper aquifer bores had a below average groundwater level status; only 11 per cent of the upper aquifer bores had an above average status. The five-year trends in upper aquifer groundwater levels were mostly stable (54 per cent) or declining (30 per cent) while only 16 per cent were rising (Figure 19). Similarly, groundwater levels of middle and lower aquifer bores were mainly below average to average with stable or declining trends.

In drought affected areas, including the Murray–Darling Basin, most bores had below average groundwater levels and declining trends (Figures 18 and 19). Areas of high groundwater extraction (for example, the upper and middle alluvial aquifers in the northeast of the Murray–Darling Basin) were particularly affected. The low groundwater levels in the Murray–Darling Basin reflect limited aquifer recharge due to the poor rainfall conditions experienced across the region over the last two years. There has also been an increased reliance on groundwater for agricultural use in these areas as surface water availability is low.

8 www.bom.gov.au/water/groundwater/insight

9 South Australia has a shorter reference period (2007–2019) due to data availability within the Bureau. This means that the results for South Australia are not directly comparable to the rest of the country.

Similarly, bores in the Darwin and Daly–Roper water control districts had below average groundwater levels and declining trends (Figures 18 and 19) due to the poor rainfall conditions across northwestern Australia during the year. Groundwater level recovery peaks in the Tindall Limestone Aquifer were the lowest in over 20 years.[10]

In contrast, areas that experienced wetter conditions, such as Queensland's northeast coast, had a high number of bores with above average levels and rising trends (Figures 18 and 19), reflecting the high rainfall and flooding throughout the region in early 2019.

In southwest Western Australia, groundwater levels remained low compared with the historical average (Figure 18); however, the higher winter rainfall of the past three years has resulted in many bores across the region showing an increasing or stable trend (Figure 19). The groundwater level recovery peaks in the Gnangara and Jandakot mounds near Perth were the highest in more than nine years.

Figure 20 summarises groundwater level status and trend by aquifer group for each State and Territory, for 2017–18 and 2018–19. There has been an increase in the number of bores with below average levels and declining trends across most Australian States and Territories as a result of the widespread drought.

10 www.bom.gov.au/water/groundwater/explorer/map.shtml?search=ngis_bore&hydroid=RN029429

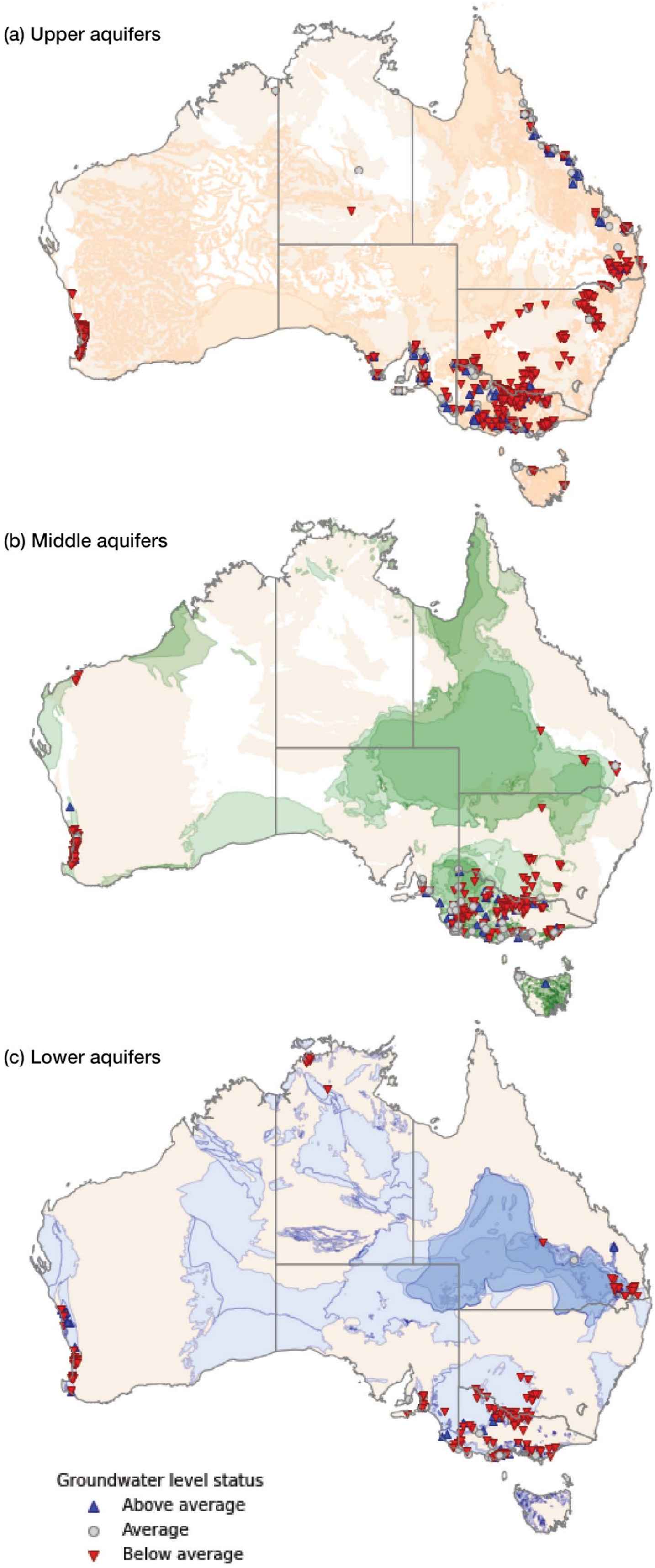


Figure 18. Groundwater level status in 2018–19 compared to the historical record (1997–2019) for (a) upper, (b) middle and (c) lower aquifers

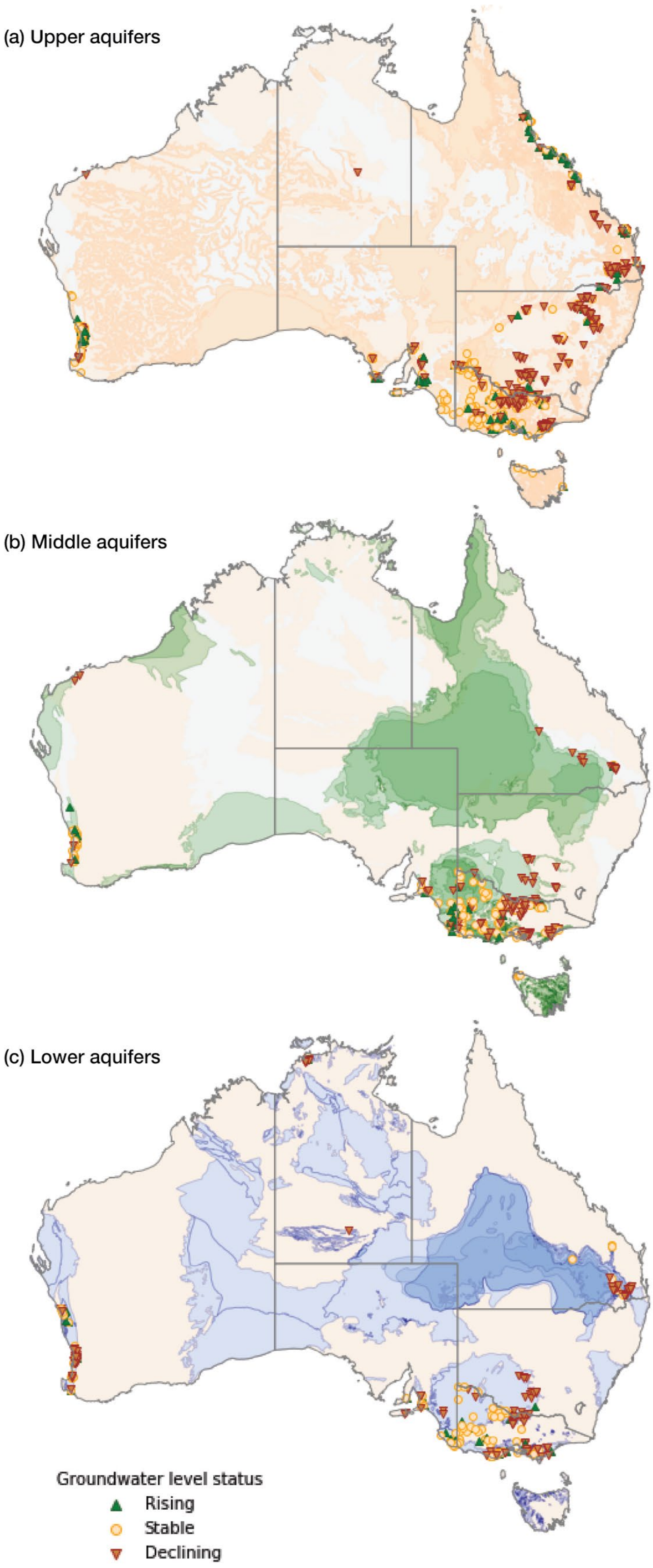


Figure 19. Groundwater level trends from July 2014 to June 2019 for (a) upper, (b) middle and (c) lower aquifers

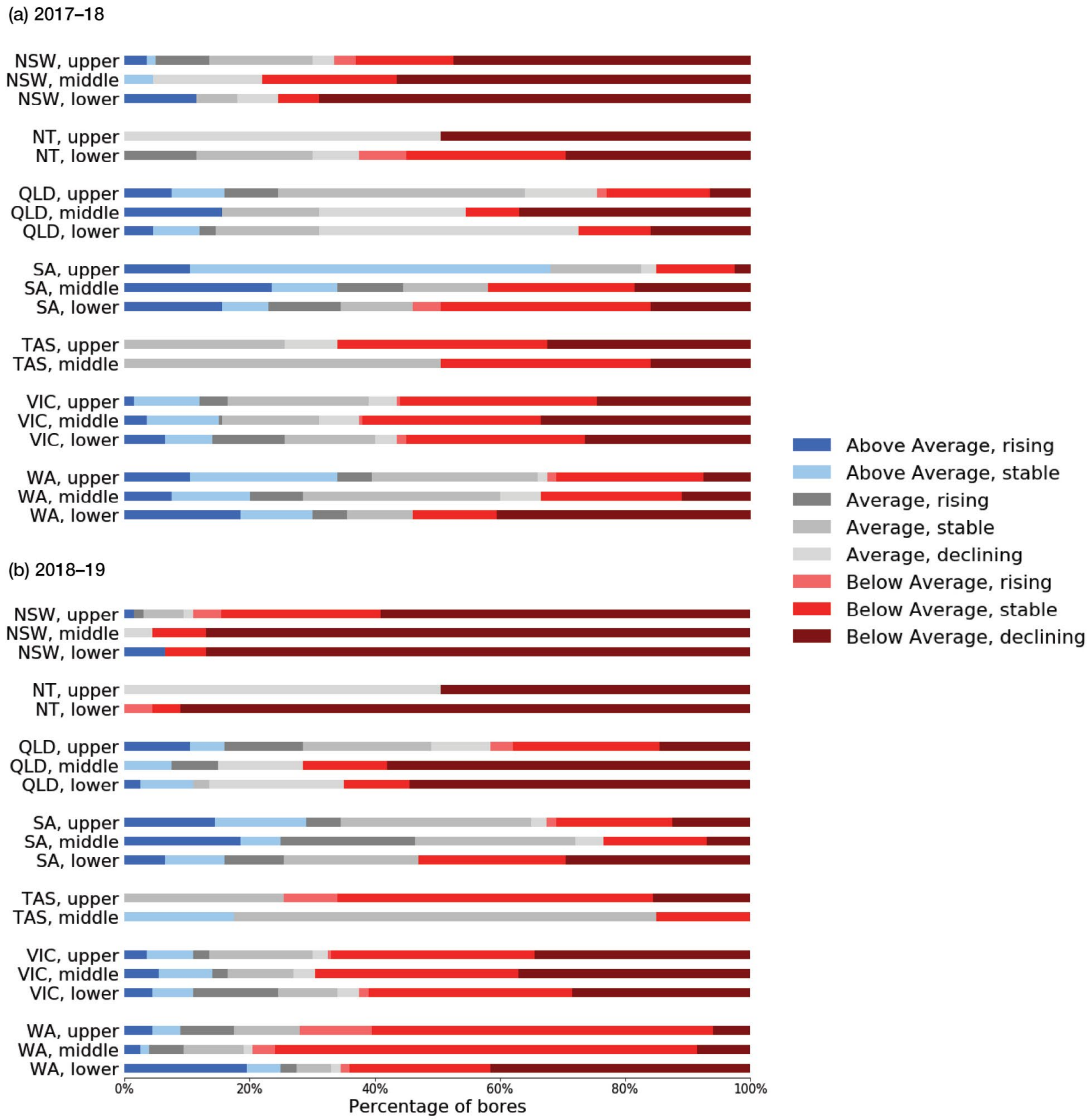


Figure 20. Summary of groundwater level status and trends by State and Territory (a) 2017–18 (b) 2018–19

2.5 ALTERNATIVE WATER SOURCES

2.5.1 Desalinated water

Urban centres across Australia face the challenges of growing populations with increased water needs and often a declining reliability of existing water resources. This can arise from aging of assets, sedimentation of storages, changes to climate and a deterioration in water quality. Climate-resilient sources such as seawater desalination and water recycling have been introduced to improve the security of urban water supply, especially in dry periods.

Australia has around 270 desalination plants, mostly small scale, to desalinate marine and brackish water for various uses.[11] The total desalination capacity across Australia is about 880 GL of water per year. The five major urban centres in Australia have a total seawater desalination capacity of 534 GL per year.

11 https://www.water.vic.gov.au/water-grid-and-markets/victorian-desalination-project/desalination-background/desalination-history

Due to a steady decline in streamflows to the Perth water storages over the past four decades, a major desalination plant was built in 2006, followed by a second in 2013. The combined production capacity of the two plants is 145 GL/year (Figure 21). In 2018–19, following three consecutive years of high storage inflows, surface water provided the major source of urban supply and the region's desalination plants were not required to run at near capacity for the first time in several years (contributing only 89 GL or 31 per cent of the total urban water sourced).[12]

Adelaide sourced around 5 GL of desalinated water, which accounted for 3 per cent of the total urban water sourced, similar to the previous year.

12 www.bom.gov.au/water/nwa/2019/urban/index.shtml

In Melbourne, desalinated water was first supplied in 2016–17. The contribution from the desalination plant in 2018–19 was 22 GL compared to 15 GL in 2017–18. An order of 125 GL of water, the largest order yet for the desalination plant was announced for the year 2019–20 (Department of Environment, Land, Water and Planning, 2019).[13]

In January 2019, Sydney's desalination plant commenced operation for the first time since 2012 when the supply system's total accessible storage capacity dropped below 60%. An amount of 7.8 GL of desalinated water was supplied during 2018–19, equivalent to 1% of Sydney's urban water supply.

In South East Queensland, 6.4 GL of desalinated water was produced in 2018–19, equivalent to 2 per cent of the total urban water supply. The contribution of desalinated water to urban supply was the highest since 2010–11.

13 https://www.melbournewater.com.au/water/securing-our-water-supply/how-water-sector-taking-action/desalination

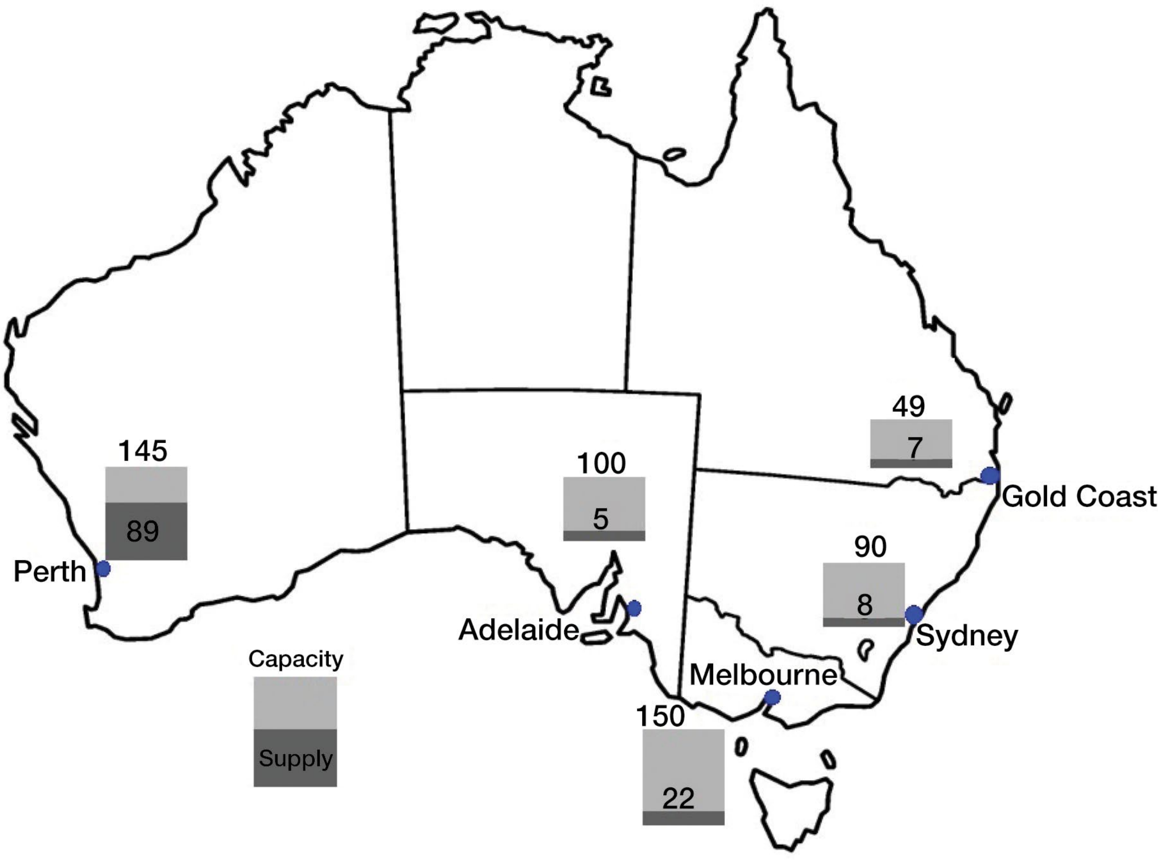


Figure 21. Desalination capacity (GL) and supply (GL) of major urban centres in 2018–19

2.5.2 Water recycling

Water recycling involves treating wastewater to a suitable standard so that it can be used for beneficial uses such as irrigation of public places, non-potable domestic uses, agricultural irrigation, industrial uses and groundwater recharge. Water recycling is attractive in situations where available sources cannot meet the growing demand. Another advantage is its reliability of supply: water is consistently available throughout the year as it is produced from wastewater flow from the cities. Water recycling also protects the environment by reducing the amount of treated wastewater discharged to the receiving waters.

Total recycled water used in major urban centres in Australia was 124 GL, about 80 per cent greater than the 70 GL used in 2010–11. Recycled water is equivalent to 7 per cent of the total water sourced in major urban centres. This use will grow as new housing estates in metropolitan growth corridors adopt dual pipe systems to supply recycled water.

In 2018–19, recycled water use increased in all the major urban centres in comparison to the previous year, except Canberra and Perth (Figure 22). The total volume of recycled water sourced for the major urban centres increased by 11 per cent; the increase was by 19 and 16 per cent in South East Queensland and Melbourne, respectively. In both Adelaide and Sydney water recycling increased by 15 per cent. In Canberra and Perth water recycling declined by 25 and 28 per cent, respectively.

Amongst all the major urban centres, Melbourne had the highest recycled water use of 51 GL, a 15 per cent increase from previous year (Figure 22). Melbourne Water produces this at two treatment plants and only 16 per cent of the total wastewater treated was reused. Adelaide had the second highest recycled water use in Australia of during 2018–19, amounting to 31 GL.

Though South East Queensland hasn't experienced any drinking water scarcity in 2018–19, it has a water security plan in place to prepare for future droughts. The Western Corridor recycled water scheme is recommissioned, and it has a capacity to deliver 65.7 GL/year of treated water. The scheme is to be used when the storage volume of the SEQ system drops below 60 per cent. It includes three advanced water treatments plants ((Bundamba, Gibson Island and Luggage Point), about 220 km of pipelines and nine pumping stations. In 2018–19, 1.7 GL of recycled water was produced for industrial use (Queensland Audit Office, 2019[14]).

14 https://www.qao.qld.gov.au/sites/default/files/2019-11/water-2018-19_results_of_financial_audits_report_4-2019-20.pdf

As reported in *Water in Australia 2017–18,* stage 1 of Perth's Groundwater Replenishment Scheme is fully operational. Construction of stage 2 is currently under way. The construction of four recharge and four monitoring bores across two recharge locations, Wanneroo and Neerabup, along with 13 km recharge pipeline connecting the water recycling plant with the bores have been completed (Water Corporation, 2019). This will provide a new climate resilient water source for Perth and it is expected that 20 per cent of Perth's water supply will be supplied from groundwater replenishment by 2060 (Water Corporation, 2017).

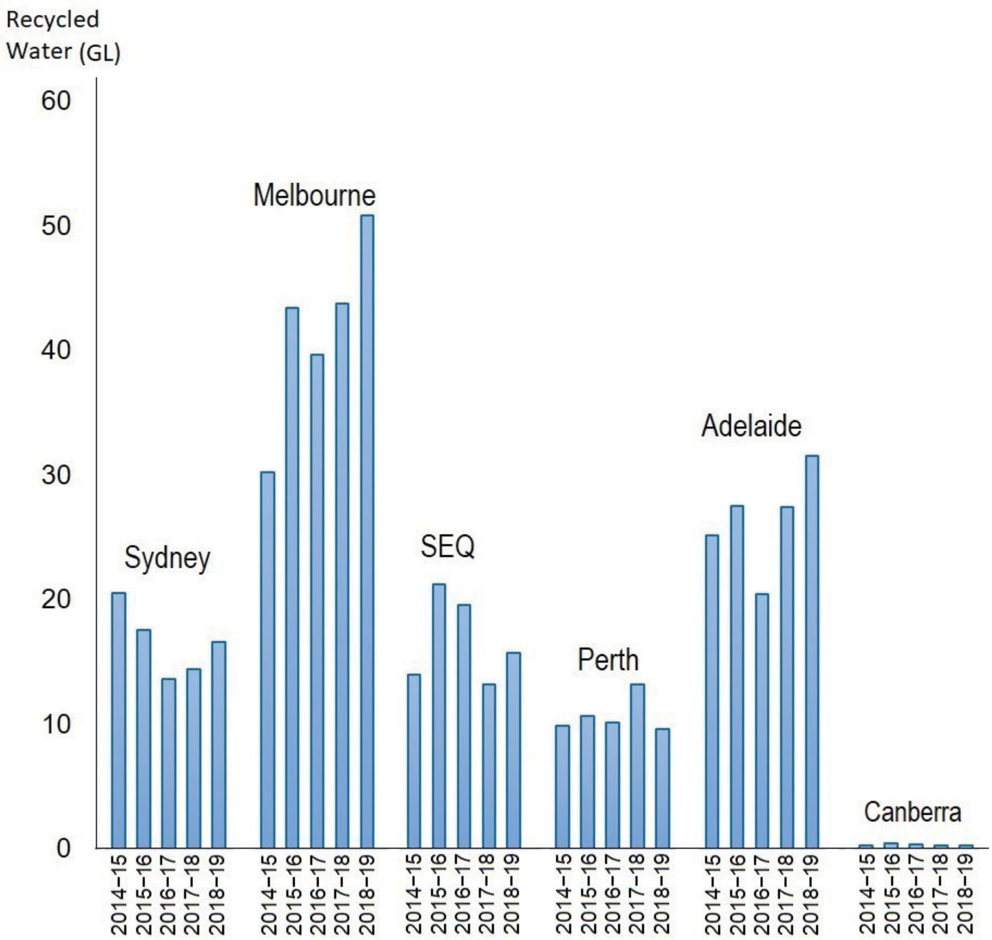


Figure 22. Recycled water used in major urban centres

3 WATER TRADING AND USE

This chapter begins with an overview of water trading in Section 3.1 and then in Section 3.2 summarises the water extractions for rural (mainly agricultural), urban and other industrial uses in comparison to what was used in the past. Water use by environmental water holders is discussed in Section 3.3 and Aboriginal cultural water needs are addressed in Section 3.4. Section 3.5 considers groundwater extractions in Australia's groundwater management areas and water availability is compared to use in National Water Account areas in Section 3.6.

3.1 WATER TRADE

Water markets facilitate the buying and selling of water entitlements and allocations to allow water to move between various rural, agricultural and environmental uses. However, water trading occurs mainly between agricultural users across Australia. Entitlement trades involve the permanent trade or leasing of water access entitlements, while allocation trades involve the buying and selling of specific volumes of water each year.

Water trade prices are determined by the value placed on water by buyers and sellers in response to many factors such as the purpose of water use, weather patterns, available allocations, storage volumes, jurisdictional legislative arrangements and commodity market conditions. Generally, higher storage levels and carryover from the previous year are major drivers for low water trade prices. In contrast, dry climate conditions push up prices for both allocation and entitlement trade. Due to the dry conditions experienced during 2018–19, average allocation prices tripled, and average entitlement prices increased by 10–20 per cent compared to the previous year.

The total volume of surface water allocation trade across Australia in 2018–19 was 5518 GL, a 24 per cent decrease from the previous year due to the prolonged drought experienced in many parts of the country. The volume of surface water traded in the southern Murray–Darling Basin was close to 5000 GL and over 300 GL in the northern Murray–Darling Basin. The volume of groundwater allocation traded in the Murray–Darling Basin was 268 GL, up by 20 per cent from the previous year, and 13 GL in the rest of Australia.

The volume of entitlement trade in Australia increased by 8 per cent in 2018–19 in comparison to the previous year. The volume of entitlements traded was 1731 GL in 2018–19 in comparison to 1598 GL in previous year. The detailed assessment of water trade is given in the Australian Water Markets Report (Bureau of Meteorology, 2020).[15]

15 www.bom.gov.au/water/market/reports.shtml

3.2 WATER ABSTRACTIONS FOR CONSUMPTIVE USE

3.2.1 Total water abstractions

The total volume of water abstracted (taken) for consumptive use is defined here as all licensed water abstractions from rivers, storages, high-yielding aquifers and desalination plants that are not used for environmental or cultural purposes. Using this definition, the estimated total volume of water abstractions across Australia during 2018–19 is estimated as 15 100 GL. This is ten per cent lower than the figure reported for 2017–18. Water abstracted for agricultural use (10 500 GL) accounted for 70 per cent of the total, followed by water abstractions for urban use (3050 GL) at 20 per cent (Figure 23). Water abstractions for both agricultural and urban use declined in comparison to the previous year.

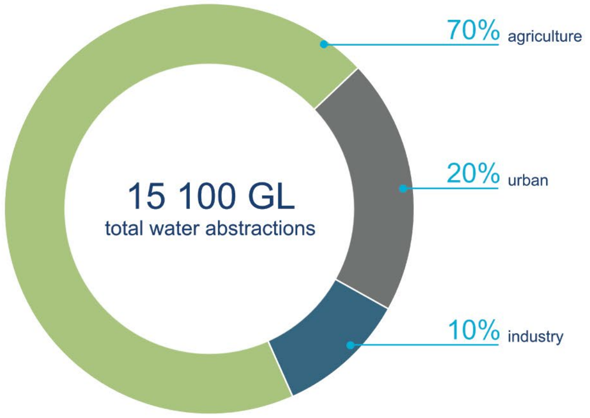
Water abstracted for other industrial purposes (1550 GL) accounts for ten per cent of the total water use. This estimate is based on the five-year average of water consumed by the mining, manufacturing, electricity and gas supply, and other industrial categories given in the Water Account, Australia (Australian Bureau of Statistics, 2018).[16]

16 www.abs.gov.au/ausstats/abs@.nsf/mf/4610.0

Surface water made up 81 per cent of total water sourced and the groundwater portion was 18 per cent (Figure 23). The portion of total water sourced from groundwater increased from the previous year, due to the low surface water allocations for agriculture.

Water abstractions for agriculture, urban and industrial uses from 2013–14 to 2018–19 are shown in Figure 24. Total water abstractions for consumptive use was the highest in 2013–14 and the lowest in 2018–19, following the trends of agricultural water abstractions. The water abstractions for urban users varied between 3050 GL and 3900 GL and was the lowest in 2018–19 due to a drop in water availability arising from dry conditions in some urban regions.

The proportion of total water sourced by agricultural, urban and industrial uses varied between years. The proportion of water abstracted for agricultural purposes was the highest in 2014–15 (73 per cent) and the lowest in 2015–16 (69 per cent). In contrast, urban and industrial proportions were the highest in 2015–16 (21 per cent and 11 per cent respectively) and the lowest in 2014–15 (11 per cent and 9 per cent, respectively).



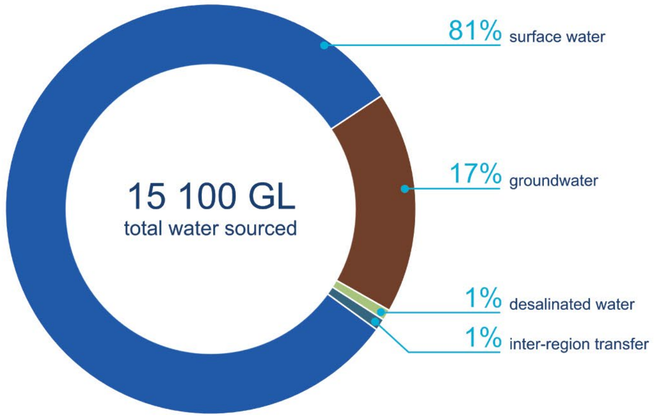


Figure 23. Water taken by use category and source in 2018–19

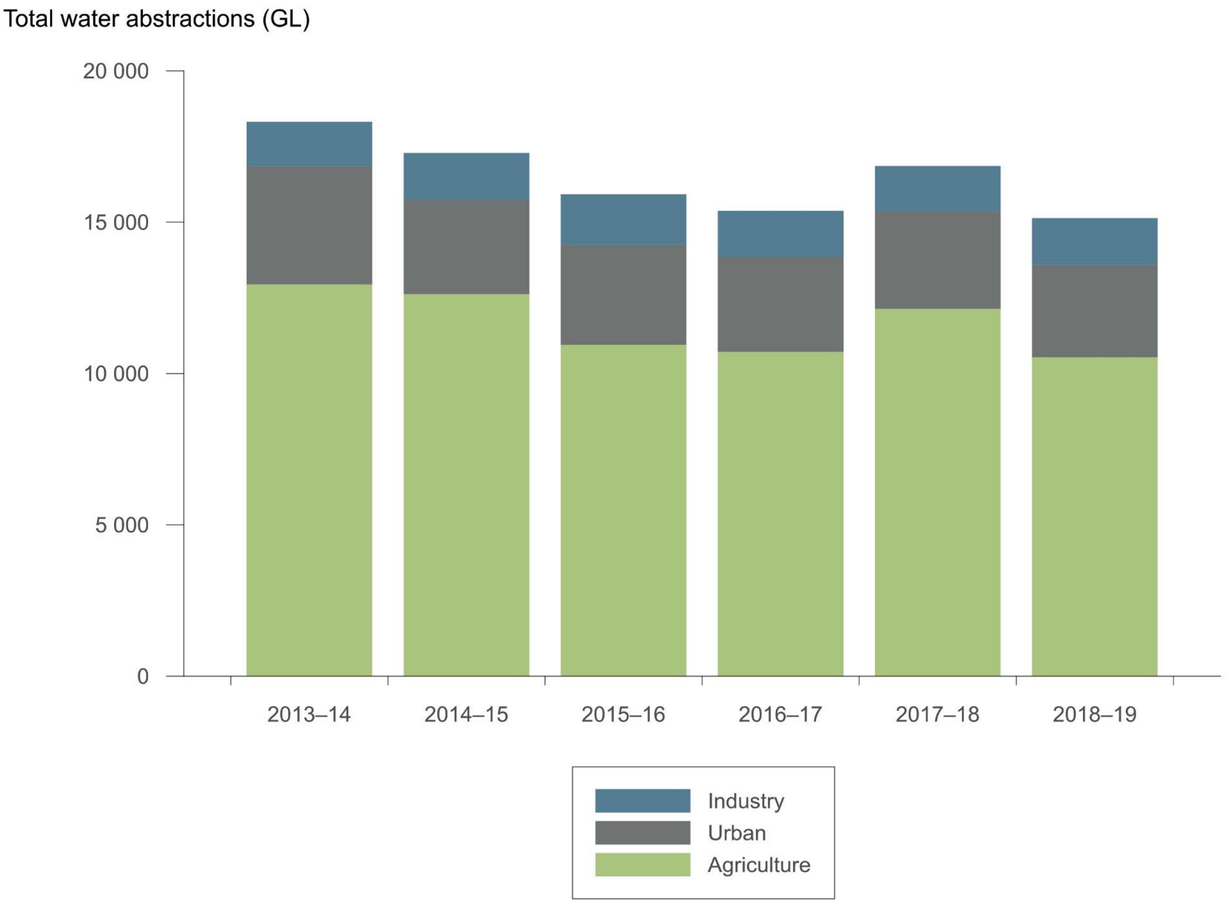


Figure 24. Historical water abstractions for agriculture, urban and industrial users

3.2.2 Water abstractions for agriculture

The total water abstracted for agriculture in Australia in 2018–19 is estimated at 10 500 GL, of which 8100 GL (77 per cent) was sourced from surface water and 2400 GL (23 per cent) from groundwater. The annual total decreased by 14 per cent from the previous year; surface water abstractions decreased by 15 per cent and groundwater extractions by nine per cent.

Water abstractions for agriculture dropped in New South Wales, Queensland and South Australia and increased in all other States and Territories (Tasmania, Western Australia, Northern Territory and Victoria). In all States and Territories except the Northern Territory, surface water diversions were higher than those for groundwater. In the Northern Territory the groundwater extractions were 98 per cent of the total.

Victoria and New South Wales abstracted the greatest proportion (31 per cent each) of the nation's agricultural water in 2018–19 (Figure 25). The Northern Territory abstracted the least water for agriculture (1 per cent), followed by South Australia (4 per cent), and Tasmania (6 per cent).

In New South Wales, the total water abstraction for agriculture in 2018–19 was 29 per cent lower than in 2017–18: surface water abstractions decreased by 41 per cent but groundwater extractions increased by 15 per cent. Low storages and low surface water allocations due to the dry conditions during the year resulted in less water available for license holders. Low surface water allocations resulted in farmers using more groundwater to satisfy their irrigation requirements.

Both surface water and groundwater abstractions in Queensland dropped during 2018–19 by 26 and 45 per cent, respectively, in comparison to the previous year. The surface water abstractions dropped from 1556 GL to 1157 GL whereas groundwater abstractions dropped from 452 GL to 249 GL. This may be due to a significant drop (45 per cent) in the area planted during the winter season.

In Victoria, surface water diversions decreased by 4 per cent and groundwater extractions increased by 55 per cent in comparison to the previous year due to dry conditions during the year. In Victoria the year started with low opening allocations for High Reliability water shares, but they steadily increased reaching 100 per cent during the middle of the year and remained at that level until the end of the season. The increase in groundwater diversions in Victoria is due to farmers supplementing low surface water allocations with groundwater.

In Western Australia surface water abstraction increased by more than 100 per cent from 462 GL in 2017–18 to 968 GL in 2018–19. This was mainly due to a significant increase in surface water abstraction from Lake Argyle in the Ord River basin arising from continued dry weather and expansion of agricultural areas. Groundwater use (434 GL) was slightly above that of the previous year (425 GL). Surface and groundwater abstractions accounted for 69 and 31 per cent, respectively, of the total water sourced. In the previous year, the comparable figures were 48 and 52 per cent.

Water abstractions for agriculture in 2018–19 was the highest for the past five years in Victoria, Tasmania, Western Australia and the Northern Territory and the lowest in New South Wales, Queensland and South Australia. Both surface and groundwater abstractions were the highest for the previous five years in Tasmania and Western Australia but in the Northern Territory and Victoria groundwater abstractions were the highest. The surface water abstractions in the Northern Territory remained similar to those for the previous three years. Surface water abstractions were the lowest in the previous five years in New South Wales whereas groundwater extractions were the highest. In Queensland both surface and groundwater abstractions were the lowest. In South Australia groundwater extractions were significantly low compared to the previous four years.

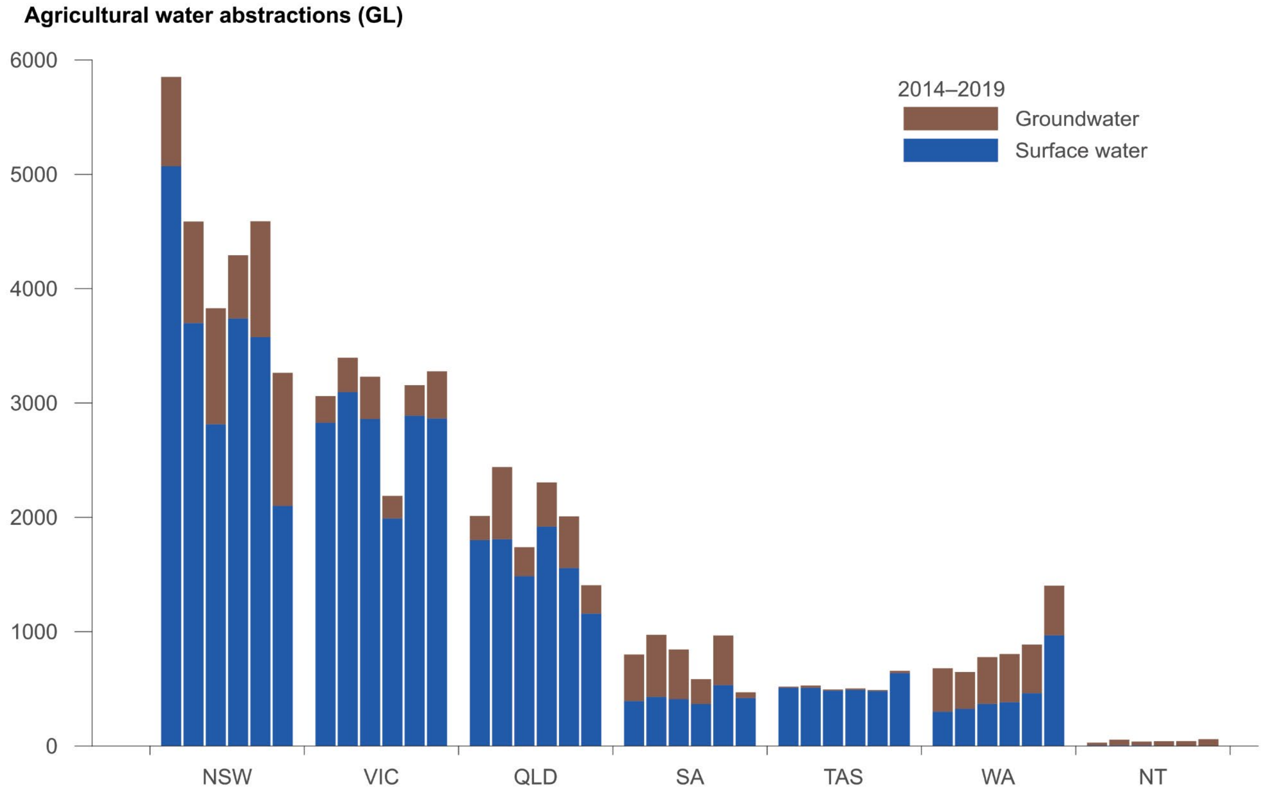


Figure 25. Volume of agricultural water abstractions from surface water and groundwater in each State and Territory, 2014–15 to 2018–19[17]

Low surface water allocation due to the dry conditions during the year resulted in low water abstractions in the southeastern mainland States except Victoria. In Victoria both surface and groundwater diversions were the highest in the past five years as farmers supplemented low allocations with carryover, trade and groundwater. In New South Wales, and to a lesser extent in Victoria, groundwater reduces the fluctuations in surface water availability for agriculture.

The variation in surface water abstractions was low in both Tasmania and Western Australia from 2013–14 to 2017–18. Surface water abstractions increased in Tasmania and Western Australia in 2018–19 in comparison to previous five years due to dry conditions and the expansion in agricultural areas.

3.3 WATER SOURCED BY URBAN UTILITIES

In 2018–19, urban utilities across Australia extracted 3050 GL from surface water, groundwater and desalinated water. Surface water contributed about 87 per cent, similar to the previous year. Groundwater and desalination supplies contributed about 8 per cent and 5 per cent, respectively. Total urban water sourced in 2017–18 was around 3200 GL. The 5 per cent decrease in 2018–19 is attributed to drops in consumption due to dry conditions in some urban regions. Water restrictions were declared in many centres due to rapid drops in storage volumes.

17 These data were based on non-urban divisions in the National Water Account 2019 (www.bom.gov.au/water/nwa/2019), and supplemented by data sourced online or received directly from State data providers for regions outside the National Water Account regions.

The average annual volume of residential water supplied per property in major urban areas was 216 kL in 2018–19, 1 per cent higher than the previous year. The increase is mainly due to low rainfall in many areas. Average residential water use per property increased in all major urban centres in 2018–19 in comparison to the previous year except in Perth (which was the same as the previous year) and Sydney (which experienced a 7 per cent decline).[18] Average residential water supplied in Perth had declined steadily from 254 kL per property in 2013–14 to 219 kL per property in 2017–18. Adelaide and Canberra reported the largest increase (4 per cent), followed by Darwin (3 per cent). Average residential use in Adelaide increased from 195 kL per property in 2017–18 to 202 kL per property in 2018–19. In Canberra it increased from 197 to 204 kL per property.

Average annual residential water use increased by 2 per cent in Melbourne and South East Queensland. Water use in Darwin increased by 3 per cent, from 368 kL per property in 2017–18 to 380 kL in 2018–19. In Sydney average annual residential water use declined from 215 kL per property to 199 kL as a result of reduced consumption due to declining water availability in the urban water storages.

Darwin had the highest average urban water use per property (380 kL), followed by Perth (219 kL). Average residential water supplied was the lowest in Melbourne (151 kL) reflecting ongoing water saving measures.

The average annual residential water use is influenced by several factors, including climate, rainfall, water restrictions, water availability, housing density and water prices. The increase in average annual residential water use in major urban centres except Sydney (decreased) and Perth (no change) during 2018–19 may be due to increase in the demand for outdoor watering arising from the dry conditions. In Sydney water use declined due to the water restrictions in place and decline in water availability in urban storages.

Overall, inter annual change in average residential water use is very low in major urban centres. However, in the last five years Perth's average annual residential water use has steadily decreased (by about 10 per cent in total), yet Perth remains one of the highest water-using cities in Australia. In Adelaide and Melbourne water use is high in dry years (2015–16 and 2018–19) reflecting an increase in demand for outdoor watering.

3.3.1 Sources of water for major urban centres

Major urban water supplies rely on surface water from reservoirs and, to a lesser extent, on groundwater resources, both of which are highly susceptible to variability in rainfall. Due to increased demand and changes in the reliability of these sources, cities have adopted a variety of approaches including extending their water supply catchment areas to more remote areas, investing in non-traditional sources such as desalination and recycling, as well as exploring options for stormwater use and rainwater harvesting.

In 2018–19, surface water sourced from local reservoirs was the main source of urban water supply in all major urban centres in Australia except Adelaide and Perth. In Adelaide inter-regional supply was the dominant source whereas in Perth groundwater and desalination were the main sources. Except for Adelaide, Melbourne and Sydney, surface water diversions were larger in the major urban centres in 2018–19 compared with the previous year (Figure 26).

For comparison purposes, total water sourced is considered here as the sum of surface water, groundwater, desalinated and interregional transfers. Recycled water is not included in the total water sourced as it is obtained internally from water already sourced elsewhere. In Figure 26, recycled water volumes are shown on top of the total water sourced.

18 www.bom.gov.au/water/npr/index.shtml

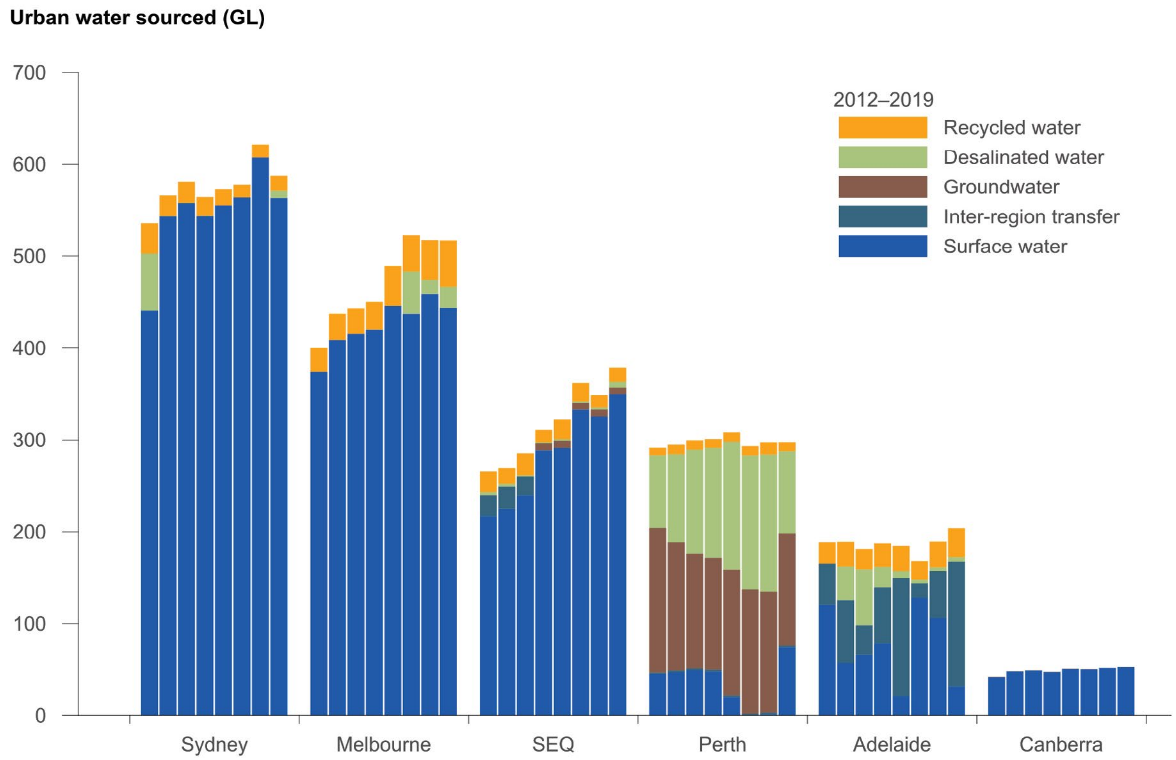
In Sydney, 571 GL was sourced for urban water use, a 6 per cent decrease from the previous year.[19] The decrease was mainly due to low water consumption as a result of persistent drought. Level 1 water restrictions, which limit how and when water can be used outdoors, were introduced from 1 June 2019 as dry conditions continued in the region. The contribution from surface water was 99 per cent and the remaining 1 per cent was from desalination. About 3 per cent of the total sourced was recycled.

Total water sourced for urban use in Melbourne in 2018–19 was 466 GL, a 2 per cent decrease from the previous year. Surface water contributed 95 per cent of that sourced and 5 per cent was from desalination. The contribution from groundwater was minimal. About 11 per cent of the total water sourced into Melbourne was recycled.

19 www.bom.gov.au/water/nwa/2019

In South East Queensland, the total water sourced was 363 GL in 2018–19, 8 per cent higher than that of previous year. This is the highest increase of all major urban centres. About 96 per cent of total was supplied from surface water. The contributions from groundwater and desalination were about 2 per cent each and the contribution from inter-regional supply was minimal. About 4 per cent of total water sourced was recycled.

Water sourced for urban use in Adelaide increased by 7 per cent from 2017–18 to 2018–19, the second highest increase of all the major urban centres. About 18 per cent of this was sourced from surface water and 79 per cent through interregional transfers (from the River Murray) compared with 66 per cent from surface water and 32 per cent through interregional transfers in 2017–18. This increase in interregional transfers was mainly due to reduced water availability in urban storages arising from below average rainfall in the catchments. The contribution from desalination was similar to the previous year at about 3 per cent of total water sourced. About 18 per cent of the total water sourced was recycled.



Source: National Water Account 2019
Note: Total water sourced is equal to the sum of surface water, groundwater, desalinated water,and interregional transfers. Recycled water is not included.

Figure 26. Volumes and sources of urban water used annually in Australia's major urban centres, 2011–12 to 2018–19

In Canberra, 53 GL of water was sourced for urban use, which was similar to 2017–18. Surface water diversions from storages make up 100 per cent of this supply. Less than 1 per cent of urban water sourced was recycled. The recycled water use has steadily declined from 0.50 per cent of total use to 0.10 per cent since 2015–16.

The volume of water sourced for urban use in Perth in 2018–19 was similar to 2017–18. The contribution from groundwater was 43 per cent and desalination was 31 per cent in 2018–19 compared with 46 per cent and 52 per cent in the previous year. The diversion from surface water storages increased from almost zero in 2017–18 to 26 per cent in 2018–19 due to improved storage inflows. The urban water supply during the past few years relied on the supply from desalination and groundwater. Increased surface water supply during 2018–19 resulted in less reliance on these sources and the two desalination plants were run at below full capacity. Only 3 per cent of the total urban water sourced was recycled and excess groundwater and desalinated water produced during low-demand periods was discharged into the surface water storages, to buffer peak period demands.

3.3.2 Water use by other industries

Agriculture and urban water users are the main bulk water extractors in Australia. Industrial water use encompasses a broad range of sectors, including mining, manufacturing and electricity production.

The latest data available for non-agricultural industries are for 2016–17.[20] The total water consumed in Australia for industrial purposes was estimated as 1550 GL. This is the average of the water estimates from 2012–13 to 2016–17 for the mining, manufacturing and electricity generation. Of this total, mining was estimated to use 675 GL, manufacturing to use 570 GL and electricity and gas to use 305 GL.

3.3.3 Water stress

Water is essential for human activity and ecosystem functioning. Global freshwater supplies are increasingly under pressure as water requirements increase steadily with population growth, economic development and changes in consumption patterns due to improved living standards. Water availability and use vary around the world. Water stress affects many regions, and more than two billion people live in countries experiencing high levels of water stress.

To establish whether freshwater is constrained in meeting the basic needs of humans and economic development, several indicators have been developed over the past few decades to assess the relationship between water availability and water use. The United Nations Sustainable Development Goal (SDG) indicator 6.4.2 was developed by the Food and Agricultural Organization (FAO) of the UN to compare estimates of the sustainability of water use across the world.[21] Indicator 6.4.2 estimates the level of water stress as the ratio between the total volume of freshwater withdrawn by major economic sectors and the total renewable freshwater resources, after considering environmental water requirements. This indicator shows the degree to which water resources are being withdrawn to meet the demand.

Values for the SDG 6.4.2 water stress indicator for Australia for 2016–17 to 2018–19 are shown in Table 2. Although the value has increased since 2016–17, the estimates are well below the initial water stress level of 25 per cent identified by the United Nations.

These figures suggest that water stress is low for Australia on a national level but make no assessment of sub-national water shortages, which is critical considering the generally high availability and low use in northern Australia, compared to the high use in southern Australia.

Table 2. Water stress indicator values for Australia, 2016–17 to 2018–19

Year	2016–17	2017–18	2018–19
SDG 6.4.2 indicator	4.1%	6.8%	8.7%

20 www.abs.gov.au

21 www.fao.org/sustainable-development-goals/indicators/642/en

3.4 ENVIRONMENTAL WATER

The natural flow regimes of most rivers in Australia are highly variable, and this variability is critical to the functioning of their ecosystems and the maintenance of their biodiversity. Constructing weirs or dams in the river system for diverting water for human uses disrupts the natural flow cycle and can affect the health and condition of rivers and their ecosystems. Environmental water is allocated and managed to protect and restore water-dependent ecosystems. Environmental watering objectives can be met by all water in the system, including uncontrolled flows from significant rain events, water that is en route for consumptive purposes such as irrigation, and specific environmental water releases from dams.

3.4.1 Environmental water delivered

The allocation of water to all entitlement holders was low in 2018–19 due to the dry conditions in the Murray–Darling Basin. The allocation to environmental water holders was also low compared to the previous years and therefore, the environmental watering in 2018–19 targeted the highest environmental priorities to achieve the best outcomes. The majority of this water was delivered in a coordinated manner involving water holders and water managers and stakeholder groups, aiming to deliver multiple benefits from the volume of water that was released.

The total environmental flow delivered to rivers, lakes and wetlands (environmental assets) in 2018–19 from all environmental water holders and managers in the southern Murray–Darling Basin was just over 1725 GL, while the total for the northern Basin was 293 GL. This was lower than previous year due to the dry conditions and low water availability across the Basin. In the previous year, environmental water volumes delivered were 2846 GL and 285 GL in the southern and northern Basin, respectively.

Table 3 summarises the 2018–19 environmental water delivered in the Murray–Darling Basin from the Commonwealth environmental water holding, State holdings and planned environmental water (Murray–Darling Basin Authority, 2020). Detailed information regarding environmental water delivery is available in the National Water Account.[22]

22 www.bom.gov.au/water/nwa/2019

Table 3. 2018–19 environmental water delivered in the Murray–Darling Basin from Commonwealth environmental water holding, State holdings and planned environmental water. [23]

Water holders	Volume of environmental water delivered (GL)
Commonwealth Environmental Water Holder	1142
Victorian Environmental Water Holder	231
New South Wales Environmental Water Holder	406
Queensland	22
South Australia	46
The Living Murray	171
Total	**2018**

23 https://www.mdba.gov.au/sites/default/files/pubs/basin-plan-annual-report-2018-19_0.pdf

3.5 WATER FOR ABORIGINAL CULTURAL USE

Cultural flows are water entitlements that are legally owned and managed by Aboriginal people to improve the spiritual, cultural, environmental, social and economic conditions of the Aboriginal Nations (Murray and Lower Darling Rivers Indigenous Nations, 2007). Over the previous decade, water managers have been identifying opportunities for shared environmental and cultural benefits through environmental watering. More recently, in many parts of Australia, methods for the explicit provision and accounting of water for use by Aboriginal people have been under development. The National Cultural Flows Research Project, 2017[24], driven by and for Aboriginal people, was undertaken to develop methodologies to quantify water requirements to meet Aboriginal cultural flow needs.

The Murray–Darling Basin Authority in collaboration with Murray Lower Darling Rivers Indigenous Nations and Northern Basin Aboriginal Nations have commenced work with the First Nations to implement the cultural flows assessment methodology.[25] One of the environmental water releases in 2018–19 in the Murray–Darling Basin that provided cultural benefits to Aboriginal people was the watering of the Ranch Billabong in the Wimmera River (Victorian Environmental Water Holder and Melbourne Water, 2019). Detailed information regarding cultural flows is available in the National Water Account.[26]

3.6 GROUNDWATER EXTRACTIONS

3.6.1 Licensed extractions

Groundwater management areas are declared to assist in the ongoing management of groundwater, including the management of licensed entitlements. Groundwater is also extracted outside groundwater management areas across Australia, but in many jurisdictions data for these areas are sparsely collected and reported.

This is the fourth year the Bureau has received and published groundwater extraction data from lead State agencies. The data delivery and quality of data have improved with time. Interactive visualisation of extraction data within management areas boundaries is available through Bureau's Groundwater Insight application[27].

In 2018–19, groundwater extraction of just over 6138 GL was reported across Australia which is an increase of 811 GL (15 per cent) from the previous year. This increase was partly due to increases in groundwater extraction in Queensland, New South Wales, Victoria and South Australia which were linked to decreased rainfall and surface water flows (Table 4). Previous *Water in Australia* reports only included extractions for licences in Groundwater Management Areas. To provide a better representation, all licensed groundwater extractions are now included (see Table 4).

In regions where users have the option of groundwater or surface water, groundwater is generally harder and more expensive to access, so it will only be used when surface water availability is reduced. This provides a reasonable explanation for the additional groundwater used in parts of Queensland, New South Wales, Victoria and South Australia in 2018–19 compared with the previous year. In areas where groundwater is the dominant source of water, lower rainfall may also give rise to increased extraction for irrigation—such as the 26 GL increase in extraction in the Lower Limestone Coast Prescribed Wells Area in South Australia, Lower Campaspe (increase of 12 GL) and the Burdekin in Queensland (increase of 37 GL).

It is important to note that, due to legislative differences at the State and Territory level, volumes of water extracted for mining are not always included in the water information collected under the requirements of the *Water Act 2007*. This means that the numbers in Table 4 may not contain mining-related groundwater extractions, particularly for dewatering.

24 www.culturalflows.com.au

25 www.mdba.gov.au/sites/default/files/pubs/basin-plan-annual-report-2018-19_0.pdf

26 www.bom.gov.au/water/nwa/2019

27 www.bom.gov.au/water/groundwater/insight

Table 4. Groundwater extraction volumes, 2016–17 to 2018–19

State or Territory	Licensed extractions in groundwater management areas (GL)			Comment
	2016–17	2017–18	2018–19	
NSW	590	1063	1242	Major increases in 2018–19 occurred in the Lower Murray (30 GL), Lower Murrumbidgee (Deep) (30 GL) and Upper Lachlan Alluvial (10 GL).
NT	62a	99	102	Management rules have changed in the Darwin Rural Area over the past few years. The increase since 2017–18 is most likely due to improved reporting from these new licences.
QLD	854	623	983	Improved data delivery has seen a more accurate representation of extraction in 2018–19. 2017–18 had some information unavailable for example for the Upper Condamine.
SA	388	432	489	
TAS	4	3	5	
VIC	314	351	441	Major increases occurred in the Shepparton Irrigation (14 GL estimation), Lower Campaspe (13 GL) and Katunga (9 GL)
WA	2708	2756	2876	
Total	**4956**	**5348**	**6138**	

[a] Not directly comparable with the 2017–18 onwards extraction.

3.6.2 Non-licensed extraction

Water can be taken as a non-licensed entitlement for example, for domestic use or stock watering. Bores constructed for these purposes are far more numerous than bores for licensed entitlements. However, the volumes extracted per bore are much lower. Most stock and domestic use is less than 10 ML per year, and the volume of groundwater that users may extract under this right varies between States.

Estimates of non-licensed use volumes are submitted to the Bureau of Meteorology, but the data still have many gaps due to the difficulties in quantifying this measurement. In most groundwater management areas, licensed use significantly outstrips non-licensed use. However, in some groundwater management areas, non-licensed extraction can make up a large percentage of the extraction. State agencies identify these areas and manage this extraction within their planning rules. Table 5 shows examples of areas where non-licensed extractions are a high percentage of the total extraction based on data reported to the Bureau of Meteorology under Category 5g (water use information other than under a ground water licence) of the Water Regulations 2008.

Non-licensed extraction also occurs outside defined groundwater management areas, and excessive extraction can also pose problems for streamflow, groundwater dependent ecosystems and nearby groundwater users. In many jurisdictions these extractions are being identified and incorporated into more formal groundwater management frameworks to reflect the impact that extraction has on the condition and availability of the resource.

Table 5. Example areas with a high proportion of non-licensed extraction (domestic and stock) in 2018–19

Region	Licensed entitlement (GL/year)	Licensed extraction (GL/year)	Estimated non-licensed extraction (GL/year)	Non-licensed extraction (per cent of total use)	Comment
Northern Territory portion of the Great Artesian Basin	0.1	0.1	3.5	97	There is only one licence in the Northern Territory portion of the Great Artesian Basin for town water supply, while domestic and stock use is larger due to groundwater being the only source of water.
Draft Howard Water Allocation Plan Area (within the Darwin Rural Water Control District)	15	1.5	25	94	Addition of 6 GL to licensed entitlements from the previous year due to inclusion of large domestic and stock licences. Non-licensed extraction is expected to reduce in a few years as reporting from these licences improves.
Water Sharing Plan for the New South Wales MDB Fractured Rock Groundwater – Lachlan Fold Belt	71	7	70	91	Lachlan Fold Belt is a large fractured rock aquifer that is low yielding. This makes the aquifer not ideal for extracting water for agricultural, but good enough for domestic and stock.
Central Victorian Mineral Springs Groundwater Management Area	5	2.5	1	29	The groundwater use in this area is shared between domestic and stock, commercial bottling and recreational activities. The high domestic and stock extraction is probably due to the large amount of semi-rural properties who rely on groundwater.

3.7 WATER AVAILABILITY VERSUS USE IN THE NATIONAL WATER ACCOUNTING REGIONS

3.7.1 Overview

Rainfall and runoff vary greatly across time and space in Australia. Streams and rivers are the major sources of water for irrigation in the country. Storages in regulated rural water supply systems assist in redistributing water to make it available to farmlands when it is required. Analyses of physical water availability, water use permissions and actual water use helps us understand how various water accounting regions respond to changing conditions.

The National Water Account [28] provides an annual picture of water resources management for eleven nationally significant water use regions –six urban and five largely rural regions. For this analysis, information from the five rural regions has been used. The status of physical water availability, water use permissions and actual water diversion for the last five years have been analysed for the Murray–Darling Basin region and for four northern regions in Australia (Figure 27).

The combined accessible storage volume in these regions decreased from 63 per cent of capacity in June 2018 to 46 per cent in June 2019. The accessible storage volumes in both the Ord and Murray–Darling systems dropped significantly during the year.

28 www.bom.gov.au/water/nwa/2019

3.7.2 Hydrological variables

Physical water availability is calculated as the sum of storage volumes at the start of the year and estimated inflows into storages during the year. Inflows are estimated using the catchment runoff from the Australian Water Resources Assessment modelling system.[29] Water use permissions are the sum of total allocations announced during the year and carryover from the previous year. Actual water use is the total regulated diversions during the year for agricultural, urban and environmental purposes.

The status of physical water availability, water use permissions and actual water use for the last five years is shown in Figure 27 for the five National Water Accounting regions.

3.7.3 Northern Australian supply systems

The National Water Accounting regions in Northern Australia include the Ord, Daly, Burdekin, and Fitzroy systems. Though total annual rainfall and runoff vary considerably from year to year, these regions typically have high physical water availability relative to use over the year (Figure 27). River flows are strongly seasonal with major flows occurring during the wet season from October to April. Storing water is essential to meeting the needs of crops during the dry winter season. As physical water availability is generally much greater than water needs, water-use permissions and actual diversions vary little between years.

In 2018–19, inflow into the Ord system was 2005 GL, the lowest in the past five years and 45 per cent lower than the 2017–18 inflow. This reduction was mainly because of the lower than average rainfall in the catchment. Physical water availability (sum of storage and inflow) dropped by 29 per cent from 2017–18 to 2018–19 and was also the lowest in the past five years. Water use permission dropped in 2018–19 but water use (307 GL) was 35 per cent higher than the previous year and was the highest in the past five years. This increase in water use is mainly attributed to the dry conditions in the region and the irrigation expansion in the Goomig Farmlands.

Total annual rainfall was below average in 2018–19 in the Daly River catchment and the lowest since 1991–92. The poor wet season rainfall resulted in the lowest runoff in the past five years. Surface water availability declined over the year, while water allocation increased in comparison to the previous year. Around 30 per cent of the total water allocation was used. Most of the surface water diverted was for town supply and the remainder for agriculture. Surface water was lower than that of the previous year due to water restrictions put in place by the Northern Territory Government.

29 www.bom.gov.au/water/landscape

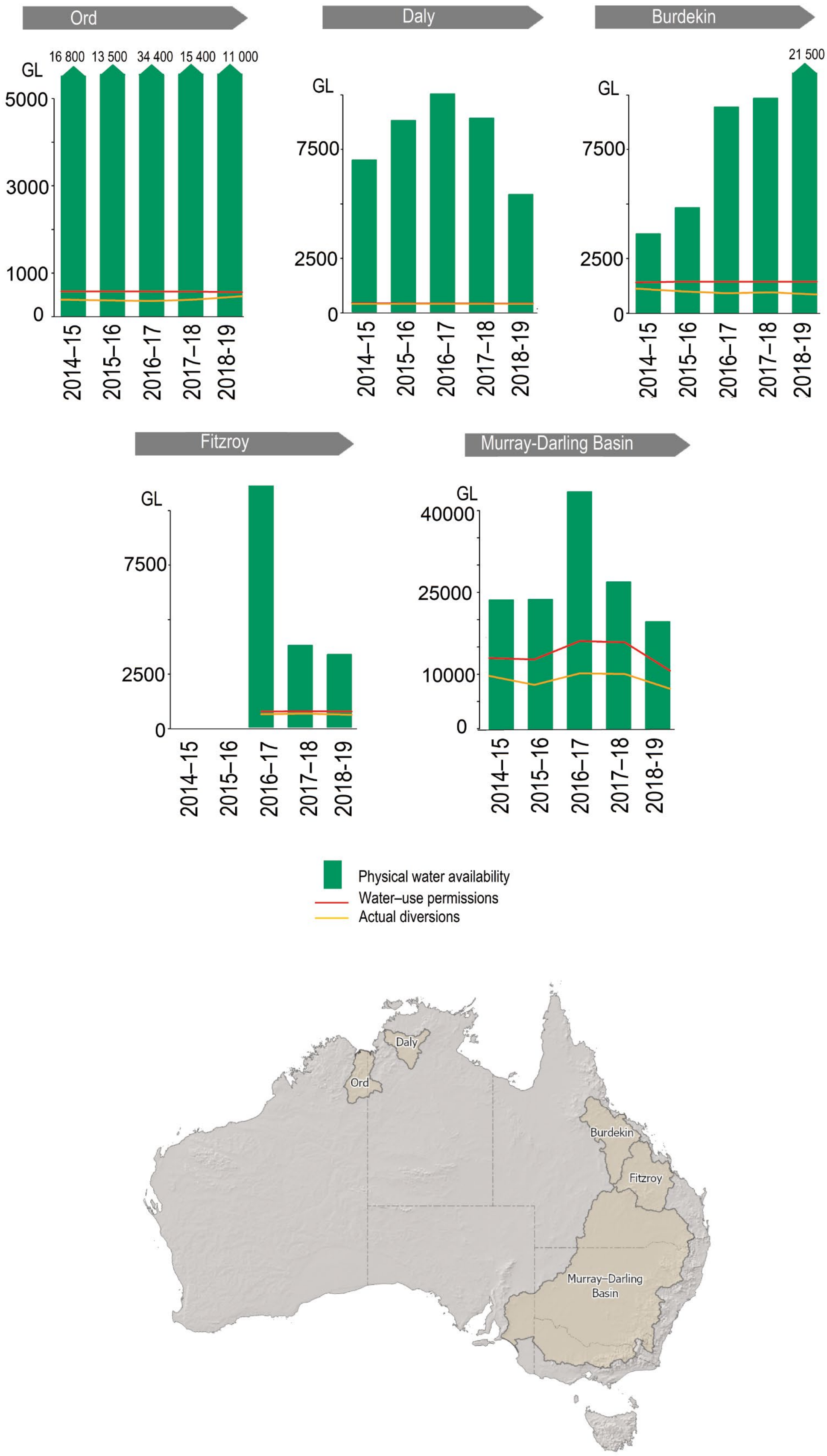


Figure 27. Volume of surface water available in northern Australia, volume of water-use permissions and volume of actual diversions, 2013–14 to 2018–19

In the Burdekin system, physical water availability increased by about 120 per cent during 2018–19, resulting in the highest water availability of the previous five years. This was mainly due to the heavy rainfall from late January to early February 2019, which contributed to higher than average runoff across the region. The combined storage volume of reservoirs in the Burdekin region exceeded 200 per cent in early February 2019 and remained above 100 per cent full until May 2019. Water use permissions were higher in 2018–19 than in 2017–18 and only 45 per cent of the surface water allocated was used. Water use was 525 GL, 17 per cent lower than in 2017–18 and the lowest in the past five years. This was mainly due to wetter conditions across the irrigation areas due to the heavy rainfall in January and February 2019.

The Fitzroy system recorded its lowest water availability of the past three years in 2018–19 due to lower than average inflows and low end of year storages from the previous year. Both water use permissions and water use declined in 2018–19 compared with the previous two years. Surface water allocation was 5 per cent less than the previous year whereas water use was 22 per cent lower. The water use was 57 per cent of the allocation in 2018–19. The low water use may have been due to reduced irrigation demand arising from less irrigation area planted in response to the below average rainfall.

3.7.4 Murray–Darling Basin supply systems

In the Murray–Darling Basin, physical water availability is generally much closer to water requirements than in the northern supply systems, and water-use permissions and actual water use can vary greatly between years. In 2018–19 water availability was 27 per cent lower than the previous year and the lowest in the previous five years. This was mainly due to lower than average rainfall across the Basin.

Water use dropped significantly in 2018–19 in comparison to the previous year (Figure 27) and was 31 per cent lower. Diversions for both agricultural and environmental use decreased significantly across the region due to decreased water availability. Water use in 2018–19 was the lowest in the past five years.

4 GLOSSARY

abstraction	The removal of water from reservoir, river, pond or channel for use.
accessible storage capacity	The volume of water that a water storage can hold between the minimum supply level and full supply level. It is the sum of this capacity that is reported for a collection of water storages.
allocation carryover	Water allocated during the water year of an entitlement that is yet to be accessed, abstracted or delivered at the end of the water year and is able to be carried over to the next water year.
aquifer	An underground layer of saturated rock, sand or gravel that absorbs water and allows it to pass freely through pore spaces.
bore	A hole drilled in the ground, a well or any other excavation used to access groundwater. May be used for observation of groundwater (including water level, pressure or quality).
carryover	The option to hold in storage a portion of unused seasonal allocations for use at a later date.
catchment	The land area draining to a point of interest, such as a water storage or monitoring site on a watercourse.
climate	The average long-term weather conditions in a particular area. See the Bureau's climate webpage at www.bom.gov.au/climate/glossary/climate.shtml for more information.
decile	One of a series of threshold values that divides a set of ordered data into ten groups with an equal number of data points in each.
desalination	The process of removing salt from brackish or saline water.
drainage division	Representation of the catchments of major surface water drainage systems, generally comprising a number of river basins. In Australia, 12 drainage divisions were first defined in the 1960s by the Australian Water Resources Council. Australian drainage division boundaries were revised by the Bureau in 2010 in line with the creation of the Australian Hydrological Geospatial Fabric (Geofabric) based on the 9 second Digital Elevation Model.
drought	A long period of abnormally low rainfall, especially one that adversely affects agriculture and other human activities. See the Bureau's climate webpage at www.bom.gov.au/climate/glossary/drought.shtml for more information.
ecosystem	A dynamic complex of plant, animal and microorganism communities and their non-living environment interacting as a functional unit.
environmental flow	The streamflow required to maintain appropriate environmental conditions in a waterway or water body.
environmental water	Water that is available, or preserved, to achieve environmental outcomes, including ecosystem function, biodiversity, water quality and water resource health.
environmental water release	Release of water from infrastructure, such as a surface water storage, for the benefit of the environment.
groundwater	Subsurface water in soils and geological formations that are fully saturated.
groundwater level	The level of groundwater in an aquifer, typically measured in a groundwater bore. In the case of an unconfined aquifer, the groundwater level is equal to the watertable level.
held environmental water	Water available under (a) a water access right, (b) a water delivery right or (c) an irrigation right, for the purposes of achieving environmental outcomes (including water that is specified in a water access right to be for environmental use).

Indian Ocean Dipole	A major contributor to rainfall variability over Australia. When the dipole is in a positive phase, sea surface temperatures (SSTs) around Indonesia are cooler than average while those in the western Indian Ocean are warmer than average. The positive phase increases easterly winds across the Indian Ocean while convection in areas near Australia reduces. This results in suppressed rainfall over the Australian region. During a negative phase, warmer than average SSTs near Indonesia and cooler than average SSTs in the western Indian Ocean, result in more westerly winds across the Indian Ocean, greater convection near Australia and enhanced rainfall in the Australian region. See the Bureau's Weather and Climate page on Indian Ocean for more information http://www.bom.gov.au/watl/about-weather-and-climate/australian-climate-influences.shtml?bookmark=iod
Millennium Drought	The prolonged period of dry conditions experienced in much of southern Australia from late 1996 to mid-2010.
planned environmental water	Planned environmental water is committed in a water plan for achieving environmental outcomes.
rainfall	The total liquid product of precipitation or condensation from the atmosphere, as received and measured in a rain gauge.
recycled water	Treated sewage effluent, including water extracted by sewer mining and subsequently treated; it does not include treated urban stormwater.
river region	Produced as part of the Australian Hydrological Geospatial Fabric (Geofabric). These regions align with, and are nested within, the revised drainage divisions.
residential water	The total amount of metered and estimated non-metered, potable and non-potable water supplied to residential properties.
salinity	The concentration of soluble salts in a solution, soil or other medium.
storage	A pond, lake or basin, whether natural or artificial, for the storage, regulation and control of water.
storage system	A water storage or group of water storages from which releases and diversions are the main source of water for users within the boundaries of a particular region, normally aligning with a river catchment.
storage volume	The volume of water stored at a particular time and date, including only the volume of water that can be accessed under normal circumstances without the installation of additional infrastructure.
stormwater	Surface runoff from rainfall events that may enter drains, creeks or streams. It can carry contaminants that may cause pollution in watercourses.
streamflow	The flow of water in streams, rivers and other channels.
surface water	Water in a watercourse, lake or wetland and any water flowing over or lying on land, having precipitated naturally or having risen to the surface naturally from underground.
urban water	The total residential, commercial, municipal, industrial and other water supplied by urban water utilities.
water abstraction	The physical abstraction of water from a water resource for use. It excludes in-system uses of water and results, at least temporarily, in a depletion of the resource. Unless water is abstracted illegally, it is abstracted under a water right. Because the right specifies a volume of water that the water provider is liable to deliver to the water user, the exercise of the right through the abstraction effectively decreases the water liability of the provider.
water access entitlement	A perpetual or ongoing entitlement to exclusive access to a share of water from a specified consumptive pool, as defined in the relevant water plan.

water access entitlement type	Water right types as defined in State and Territory legislation which includes bundled and unbundled water rights and bulk water access entitlements.
water allocation	The specific volume of water allocated to water access entitlements in a given season or given accounting period, and defined according to rules established in the relevant water plan.
water allocation trade	A transaction to transfer a water allocation from one legal entity to another, with or without a change in location, for the remaining water year (by default) or for a specified term that may be less than the end of the water year or carried over to subsequent years (that is, a lease).
water quality	The physical, chemical and biological characteristics of water. Water quality compliance is usually assessed by comparing these characteristics with a set of reference standards. Common standards used are those for drinking water, safety of human contact and the health of ecosystems.
water resource	All natural water (surface water and groundwater) and alternative water sources (such as recycled or desalinated water) that have not yet been abstracted or used.
water resource plan	A plan for the management of a water resource.
water sharing plan	A legislated plan that establishes rules for managing and sharing water between ecological processes and environmental needs of the respective water source (river or aquifer). It manages water access licences, water allocation and trading, extraction, operation of dams and the management of water flows, and use and rights of different water users.
water stress	A condition where there is not enough water to meet needs, including the effective functioning of ecosystems.
water trade	A transaction to buy, sell or lease a water right, in whole or in part, from one legal entity to another.
watertable	The groundwater surface in an unconfined aquifer or confining bed at which the pore pressure is atmospheric. It can be measured by installing shallow wells extending a few metres into the saturated zone and then determining the water level in those wells.
water year	1 July to 30 June.
wetland	An area of land whose soil is saturated with moisture either permanently or intermittently. Wetlands are typically highly productive ecosystems. They include areas of marsh, fen, parkland and open water. Open water can be natural or artificial; permanent or temporary; static or flowing; and fresh, brackish or salt. Wetlands may include areas of marine water, as long as the depth at low tide does not exceed six metres.

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