Victorian Water Accounts

2017-2018

A statement of Victorian water resources

Victoria State Government

Environment, Land, Water and Planning

Acknowledgment

We acknowledge and respect Victorian Traditional Owners as the original custodians of Victoria's land and waters, their unique ability to care for Country and deep spiritual connection to it. We honour Elders past and present whose knowledge and wisdom has ensured the continuation of culture and traditional practices.

We are committed to genuinely partner, and meaningfully engage, with Victoria's Traditional Owners and Aboriginal communities to support the protection of Country, the maintenance of spiritual and cultural practices and their broader aspirations in the 21st century and beyond.

Cover image: Ned's Corner, Mallee CMA

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Foreword

The *2017–18 Victorian Water Accounts* are the fifteenth in a series of reports that communicates to the public how the government sustainably manages water resources in our state.

The accounts use rigorous water-accounting methods to offer insights into the availability and use of Victoria's water for the year, providing a valuable account of how much was used and highlighting the different demands for water across the state.

This year's report shows that 2017–18 was a very dry year, particularly in contrast to the average and above-average rainfall received in most of Victoria in the previous year. This is a pattern that was widely observed across south eastern Australia. Following on from the driest June on record in 2017, Victoria then experienced its driest winter since 2006, driest autumn since 2008 and a record wet start to the summer. This is consistent with trends from recent decades of decreased rainfall in the cool seasons and increased rainfall in the warmer seasons.

As a result of the decreased rainfall, there was much less surface water available in 2017–18 compared to 2016–17 and increased restrictions on diversions from streams.

The *2017–18 Victorian Water Accounts* show that the volume of surface water, groundwater and recycled water available in 2017–18 was 15,375,034 ML, compared to 32,239,118 ML in the previous year. Of the water available, 4,087,408 ML was taken for consumptive purposes, compared to 3,633,465 ML taken in 2016–17.

The vast differences between these two years demonstrates the importance of strategic planning and adaptability. The Victorian Government together with our partners is leading the way in managing our water resources sustainably through *Water for Victoria*, our plan for responding to the pressures of climate change and population growth and for doing more with less water.

In addition to this comprehensive account of Victoria's water availability and use, I invite you to explore *2017-18 Victorian Water Accounts highlights*, at https://howmuch.water.vic.gov.au/.

This digital resource complements the written report, providing a new way to engage with water data and learn more about its management. It's another demonstration of the Victorian Government's commitment to provide clear information about water resources to the community.

THE HON LISA NEVILLE

Minister for Water

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Victorian Water Accounts 2017–18 at a glance

- These accounts provide statewide and system pictures of water availability and use for each of Victoria's 29 river basins and 20 groundwater catchments and for each of the state's rural and urban distribution systems for 2017–18.
- 2017–18 was a drier-than-average year for most of Victoria. The below-average July 2017 following on from a record dry June gave Victoria its second-driest start to winter on record (after 1982).
- In 2017–18, Victoria experienced its driest winter since 2006 and its driest autumn since 2008.
- Warm temperatures and low rainfall from January to July in 2018 increased the impact of drought in eastern Australia.
- The total available volume of surface water, groundwater and recycled water was about half of the previous year.
- In 2017–18, urban water restrictions were applied for one town. Decreased rainfall meant there were more restrictions on diversions from streams in 2017–18, with a peak of diversions restricted in 130 streams in March 2018, compared to 94 in March 2017.
- In July 2017, opening allocations were low for all entitlements in regulated systems. By February, all high-reliability entitlements received 100% except for the Werribee and Bacchus Marsh district.
- Although storages ended the year lower than they began, 28 of Victoria's regional storages reached at least 90% of capacity by September 2017, and four reached full capacity and were spilling.
- In most groundwater systems, water levels were similar to those in the previous year.
- Surface water, groundwater and recycled water use increased, compared to 2016–17.
- This year was the VEWH's seventh year managing water for the environment in Victoria. In 2017–18, 92% of identified potential watering actions were fully or partially achieved through a combination of naturally wet conditions and managed environmental flows.

About the *Victorian Water Accounts 2017–18*

The *Victorian Water Accounts 2017–18* is the fifteenth report in a series that presents annual information about the state's water resources. It covers different sources of water including surface water, groundwater and recycled water. The purpose is to report on volumes of water available and used between 1 July 2017 and 30 June 2018. This report demonstrates to the community how the government sustainably manages all water resources in Victoria.

The sharing of the information in this report is part of the government's commitment to transparency and accountability in the management of our water resources. The report provides confidence to participants in water markets and to businesses and agricultural enterprises making investments across the state that rely on secure access to water.

The *Victorian Water Accounts 2017–18* demonstrates Victoria's commitment to meet obligations under state and federal legislation to collect and publish information about the state's water resources, and they make an important contribution to meeting our reporting requirements. Ultimately, this report is a valuable resource for staff working in the water management sector, water users, other interested parties and the broader community.

The report consolidates information from rural and urban water corporations; the Department of Environment, Land, Water and Planning; the Australian Bureau of Meteorology; the Victorian Environmental Water Holder; the Essential

Services Commission; the Murray–Darling Basin Authority; the Victorian Alpine Resorts Commission; power generators; and other major users of water. The information is recorded in the *Victorian Water Register*.

The *Victorian Water Accounts 2017–18* has two parts.

- Part 1 provides a statewide overview of water resources during the year. It provides context on the legal access to water and how resources are managed. There is information about rainfall, streamflows and storage levels, water taken for consumptive purposes, water-trading and the management of water for the environment.
- Part 2 contains water accounts for each of Victoria's 29 river basins and 20 groundwater catchments. It also presents distribution system accounts for Victoria's 19 water corporations. The accounts track each system's inflows, outflows and storage volume changes during the year.

Drier conditions across Victoria

In contrast to the average and above-average rainfall in most of Victoria in 2016–17, rainfall in 2017–18 was mostly below average across the state. Rainfall was very much below average in the south-east, and some above-average rainfall was received in the south-west. In 2017, Victoria experienced its driest winter since 2006, unlike 2016 when rainfall was above the 30-year average for much of Victoria. Spring 2017 was drier than average for most of Victoria, except in the south-west where above-average rainfall was received. In contrast to spring, summer rainfall was above average in the east and below average in the west. Autumn 2018 was much drier and warmer than the previous year, with the lowest rainfall received since 2008; and it was the fourth-warmest autumn on record. This continued a run of seven consecutive autumn seasons of drier-than-average conditions in the state.

Averaged across Victoria as a whole, evapotranspiration in 2017–18 was estimated to be 474 mm, which was about 13% less than the long-term (1961–90) average evapotranspiration rate. In 2017–18, the proportion of evapotranspiration to rainfall was generally higher than the long-term average in most basins, except for areas in the south-west and north-east. This is consistent with below-average rainfall generally being observed, because the proportion of evapotranspiration to rainfall generally decreases as rainfall increases. As a result, less rainfall remained for streamflow and groundwater recharge in 2017–18 than would be the case in an average year.

Overall, 61% of long-term annual average streamflows were received in Victoria, with all 29 river basins receiving lower annual average streamflow volumes in 2017–18, compared to the previous year.

Urban water restrictions were only applied for one town, the same as in 2016–17. However, there were more restrictions on diversions from streams in 2017–18 than in 2016–17. More streams had restrictions or bans in place on licensed diversions in 2017–18: 130 streams, compared to 94 streams in 2016–17. High-reliability entitlements received 100% allocation in all but two regulated systems, compared to all systems in 2016–17.

In groundwater catchments, water level trends were similar to those in 2016–17.

Decreased water availability

A total of 15,375,034 ML of surface water, groundwater and recycled water was available in 2017–18. This is a little less than half the 32,239,118 ML available in 2016–17.

Victoria's total storage levels started the year at 8,505,602 ML — 69% of capacity — and ended at 7,242,916 ML — 58% of capacity. Although storages ended the year lower then they began, 28 of Victoria's regional storages reached at least 90% of capacity by September 2017, and four reached full capacity and were spilling.

Unlike the previous year when all high-reliability entitlements (in the north and south) reached 100% in Victoria's declared systems, in 2017–18 all high-reliability entitlements reached 100% allocation in 2017–18, except for the Werribee and Bacchus Marsh district which reached 45% allocation. In northern Victoria, the Bullarook and Broken systems reached 100% allocation for low-reliability entitlement, and low-reliability water shares in the Campaspe system reached 59%. In southern Victoria, the Thomson–Macalister district received a 20% allocation against low-reliability entitlement and the Werribee and Bacchus Marsh districts did not receive an allocation for low-reliability entitlements. Allocations for the Wimmera Mallee Pipeline product began with initial allocations of 37%, which then reached and remained at 81% after February 2018. In the Coliban Rural system, entitlement holders had access to 100% of their entitlement for the entire year.

Increased water use

In Victoria 4,087,408 ML of surface water, groundwater and recycled water was taken for consumptive use in 2017–18. This volume represents about 27% of the total water available during the year, higher than the 11% in 2016–17.

Surface water use was 3,550,404 ML in 2017–18, compared to 3,197,982 ML in 2016–17. A large portion of this difference was due to the below-average rainfall which meant that catchments were drier. More water was used for irrigation — 513,759 ML more than the 2016–17 volume — and less for urban and commercial purposes — 33,132 ML less than the 2016–17 volume.

Groundwater use also increased in 2017–18, with Victorian water users extracting 439,845 ML of groundwater, compared to 351,672 ML in 2016–17.

Recycled water use increased from the previous year, with 97,159 ML recycled in 2017–18, compared to 83,811 ML in 2016–17.

In 2017–18, the Victorian Environmental Water Holder (VEWH) oversaw the delivery of 918,615 ML of water to 88 priority river reaches and 83 wetlands, and 92% of identified potential watering actions were fully or partially achieved. The number of potential water actions has increased each year since the VEWH's inception. Despite the climate being dry to very dry, the total proportion of actions achieved in 2017–18 was the second-highest since the VEWH's establishment in 2011.

Continuous improvement of the accounts

Three main improvements have been made for these 2017–18 accounts:

- a review was conducted of the methods used to estimate in-stream losses in surface water river basins, resulting in better estimates of loss in nine basins
- the methodology used to estimate harvesting and losses from small catchment dams was updated, resulting in improved estimations of small catchment dam impacts, in most cases reducing the total impact of dams in each river basin
- estimates of long-term water availability were updated: revised long-term averages provide a better indication of the water availability in any given year against the average.

Want to know more?

More information about **sustainable water management** across Victoria can be found at:

- Department of Environment, Land, Water and Planning – www.delwp.vic.gov.au/water.

More information about water supply and use is held by **local water corporations** and can be found at:

- Barwon Water – www.barwonwater.vic.gov.au
- Central Highlands Water – www.chw.net.au
- City West Water – www.citywestwater.com.au
- Coliban Water – www.coliban.com.au
- East Gippsland Water – www.egwater.vic.gov.au
- Gippsland Water – www.gippswater.com.au
- Goulburn-Murray Water – www.g-mwater.com.au
- Goulburn Valley Water – www.gvwater.vic.gov.au
- Grampian Wimmera Mallee Water – www.gwmwater.org.au
- Lower Murray Water – www.lmw.vic.gov.au
- Melbourne Water – www.melbournewater.com.au
- North East Water – www.newater.com.au
- South East Water – www.southeastwater.com.au
- South Gippsland Water – www.sgwater.com.au
- Southern Rural Water – www.srw.com.au
- Wannon Water – www.wannonwater.com.au
- Western Water – www.westernwater.com.au
- Westernport Water – www.westernportwater.com.au
- Yarra Valley Water – www.yvw.com.au.

More information about **environmental water** can be found at:

- Victorian Environmental Water Holder – http://www.vewh.vic.gov.au/.

More information about **rainfall and temperatures** can be found at:

- Australian Bureau of Meteorology – www.bom.gov.au.

Part 1: Overview of Victorian water resources 2017–18

Part 1 of the *Victorian Water Accounts 2017–18* summarises Victoria's water entitlement and planning framework and the mechanisms it provides for sharing available water resources.

Part 1 also provides a statewide overview of Victorian water resources during the year, reporting on:

- the quantity of water available in terms of rainfall, streamflows, water storages, aquifers and desalinated water
- the quantity of water allocated for consumptive use from reservoirs, streams and aquifers under entitlements issued by government, as well as quantities used, recycled and desalinated
- water available to the environment
- Victoria's water trade activity.

1. Management of Victoria's water resources

The *Water Act 1989* is the primary legislation guiding the management of Victoria's water resources. Under the Act, the Crown retains the overall right to the use, flow and control of all surface water and groundwater on behalf of all Victorians.

The Act establishes a water entitlement framework, and the government has established a water resource planning framework, to provide for the efficient and equitable sharing of Victoria's water resources. The entitlement framework clearly specifies the legal rights and obligations of entitlement holders and the state in overseeing management of Victoria's water resources. A feature of the framework is that it gives entitlement holders flexibility and certainty about how they manage their water, and it makes them able to make decisions to manage their own risks. This flexibility and certainty underpins investment decisions by irrigators, urban water authorities and industry. The water entitlement and water resource planning frameworks are explained in chapter 1.3. Good-quality, timely water resource management information is essential for the frameworks to operate effectively.

This chapter:

- provides an overview of the types of water resources governed under Victoria's water entitlement and water resource planning frameworks
- describes the water sector's institutional arrangements for managing Victoria's water resources
- explains the key features of the water entitlement and water resource planning frameworks and how they provide flexibility to respond to seasonal variability in water availability
- describes how we monitor and report on water resources.

1.1 Types of water resources

This report covers several types of water resources, which are managed under Victoria's water entitlement and water resource planning framework. These are:

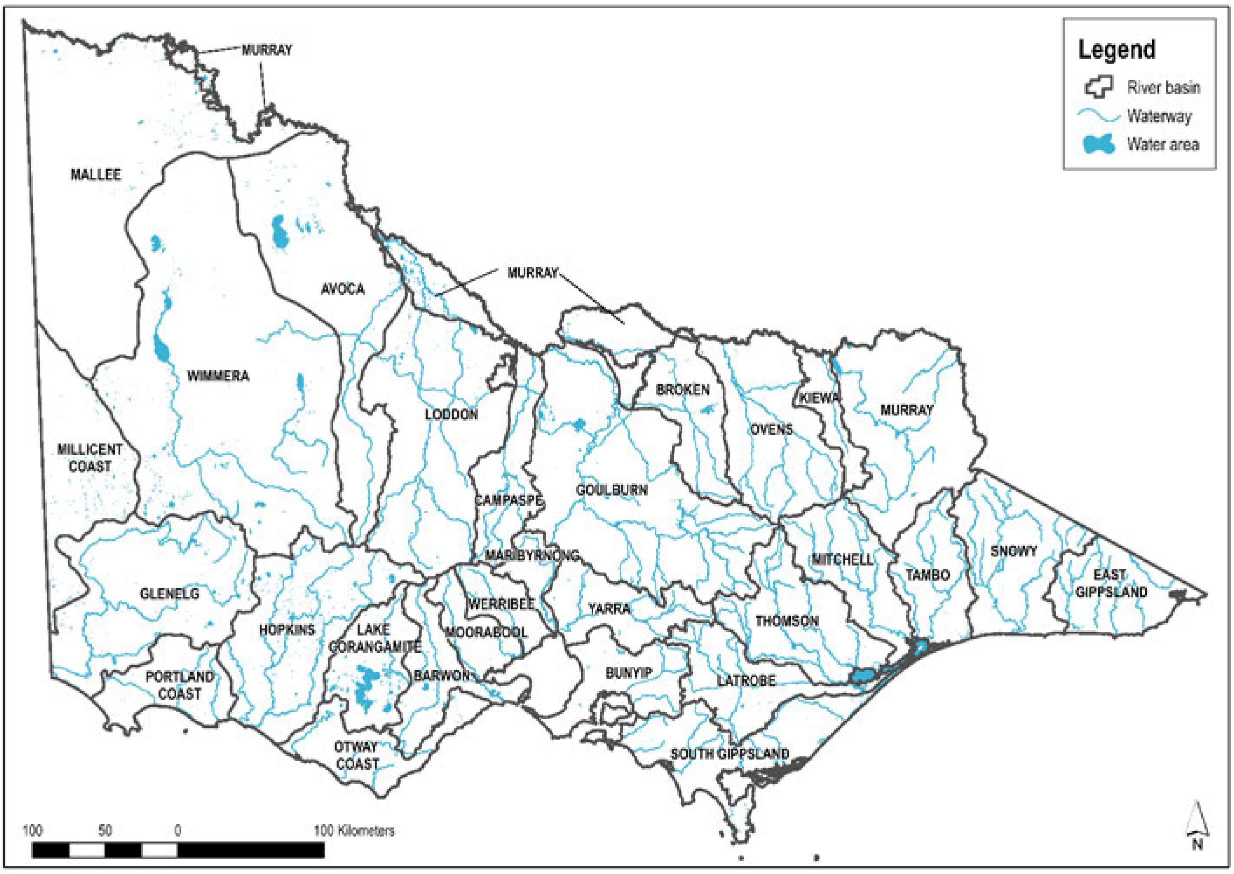
- **surface water**, which is water that occurs or flows on land. This includes water in waterways and in lakes, reservoirs, dams, wetlands and other water bodies. The term 'waterway' means a river, creek, stream, watercourse or a natural channel where water regularly flows, whether or not the flow is continuous
- **groundwater**, which is any water occurring in an aquifer: any geological formation that contains water either permanently or intermittently or allows water to pass through it
- **recycled water**, which is water derived from sewerage systems or industry processes that is then treated to a standard appropriate for its intended use
- **desalination water**, which is seawater treated to a standard appropriate for its intended use.

1.1.1 Surface water

Victoria's surface water resources include water that occurs or flows on land. For the purposes of these accounts, river basins are used as the primary reporting unit for surface water information. A river basin is the area of land drained by a river and its tributaries. Victoria is comprised of 29 major river basins[1]. The river basins in the south and east of the state drain to the sea, and those in the north drain to the Murray–Darling basin. The extent of each of Victoria's river basins is shown in Figure 1-1.

[1] The river basins defined by the former Australian Water Resource Council (AWRC) are used, except for the Murray basin. For the purposes of the water accounts, the Murray basin includes the Upper Murray basin as defined by the AWRC and the areas in Victoria that are supplied from the Murray River downstream of Lake Hume.

Figure 1-1 River basins in Victoria



Victoria's rivers and waterways can be broadly categorised as either regulated or unregulated systems.

In **regulated systems**, the flow of water in the waterway is regulated and captured through the operation of large dams or weirs. In these systems, the dams, weirs and other flow-regulating structures significantly transform the natural variability of streamflows into a more-reliable supply of water. Examples are Lake Eildon on the Goulburn system and the Dartmouth and Hume dams on the Murray system. Dams and reservoirs within waterways are known as on-stream storages.

Unregulated systems are waterways that do not have large dams or weirs controlling the streamflow. Water is taken directly from these systems by pumps or diverted to off-stream storages. The volume of water available is based purely on rainfall and run-off, not on storage. Therefore, water supplies are more susceptible to variation in streamflow, and less water is available in the drier months and in drought periods.

Surface water also includes the water captured and held in small catchment dams. In other jurisdictions, these are sometimes referred to as farm dams, hillside dams or run-off dams. These dams are not located on or fed by a waterway, and they are filled by rainfall in their catchment.

Chapter 6 provides the water accounts for each of Victoria's 29 river basins, tracking surface water from the time it appears as inflows to a waterway to the time it is diverted from the surface streams of the basin, or flows from the basin to another basin or to the sea.

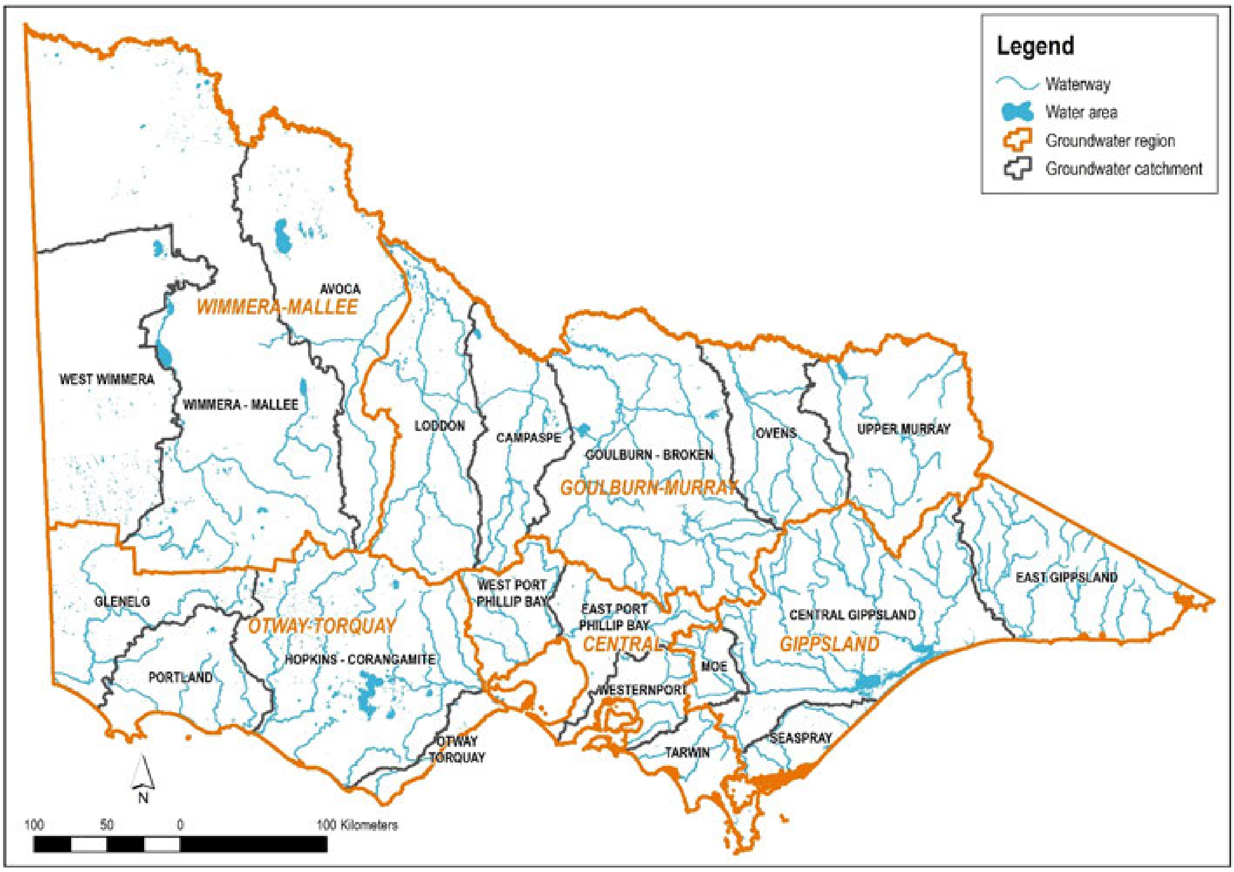
1.1.2 Groundwater

Groundwater is found in the spaces and fractures in rock and sediment beneath the ground's surface. Groundwater forms part of Earth's water cycle, when rainfall, surface water or snowmelt seeps from the surface and reaches the water table to form groundwater. Groundwater flows may eventually return to the surface as springs, baseflow into rivers and streams, lakes and wetlands, the ocean; or it may evaporate. Groundwater supports human consumption and agricultural, commercial and industrial uses, and groundwater-dependent ecosystems. It also contributes to environmental flows in streams.

Where groundwater is held within a geological formation which allows water to flow through – called an aquifer – it can be pumped to the surface for use. The flow of groundwater can vary. Some users pump groundwater from a bore and store it for use. Elsewhere, groundwater is artesian, flowing naturally due to pressure in a deep aquifer. The salinity of the groundwater is often the key determinant as to whether it is suitable for consumptive use.

Victoria's groundwater resources are contained in five major groundwater management regions. Each contains several groundwater catchments, shown in Figure 1-2, and provide the basis for planning and reporting.

Figure 1-2 Victorian groundwater regions and catchments



Chapter 7 provides the water accounts for each of Victoria's 20 groundwater catchments. It further describes Victoria's groundwater resources and accounts for irrigation, urban and domestic and stock groundwater use in each catchment.

1.1.3 Recycled water

Highly treated wastewater can be recycled for a range of non-drinking uses.

Once treated, the recycled water is delivered by water corporations to their customers through a separate (purple) pipe system that has been installed in some new developments. Recycled water is suitable for a wide range of uses including irrigation and toilet flushing.

Recycled water produced in 2017–18 is described in chapter 3.3, and recycled water use in each river basin in chapter 6.

1.1.4 Desalinated water

Desalination is the process of removing salinity (dissolved salts) from salt water. In September 2009, construction started on the Victorian Desalination Project (VDP) at Wonthaggi, to supplement Melbourne's water supply. Construction was completed in December 2012. The VDP uses reverse-osmosis technology to remove salt from seawater and so create high-quality drinking water.

The rainfall-independent VDP can supply up to 150 GL of high-quality drinking water a year, or about one-third of Melbourne's annual water consumption. The project includes a two-way underground transfer pipeline which connects the plant to Melbourne's water network through a delivery point at Berwick and transfer main to Cardinia Reservoir. Offtakes are included along the pipeline so that areas in South Gippsland and Western Port can access the water from the plant or Cardinia Reservoir if required.

The first order from the VDP was made in March 2016 by the Minister for Water. Chapters 2.3 and 3.4 and the Yarra basin in chapter 6.17.1 report on the water produced in 2017–18.

1.2 Water sector institutional arrangements

Victoria's state-owned water sector is made up of 19 water corporations constituted under the Act. The water corporations provide a range of water services to customers within their service areas.

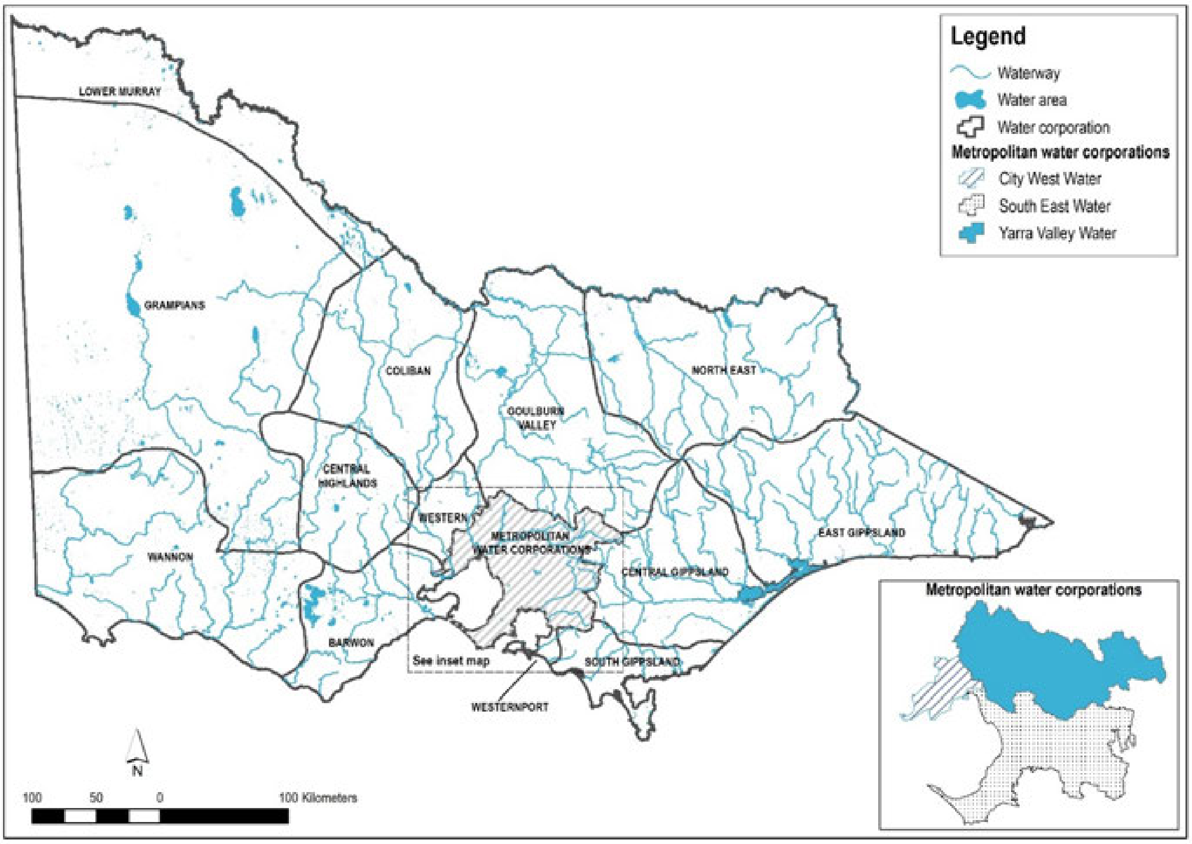
Sixteen **water corporations** provide urban water supply (including of recycled water) and sewage and trade waste disposal services to urban customers throughout Victoria. Figure 1-3 shows their areas. In regional Victoria, they are:

- Barwon Water
- Central Highlands Water
- Coliban Water
- East Gippsland Water
- Gippsland Water
- Goulburn Valley Water
- Grampians Wimmera Mallee Water
- Lower Murray Water
- North East Water
- South Gippsland Water
- Wannon Water
- Westernport Water
- Western Water.

In Melbourne, they are:

- City West Water
- South East Water
- Yarra Valley Water.

Figure 1-3 Urban supply



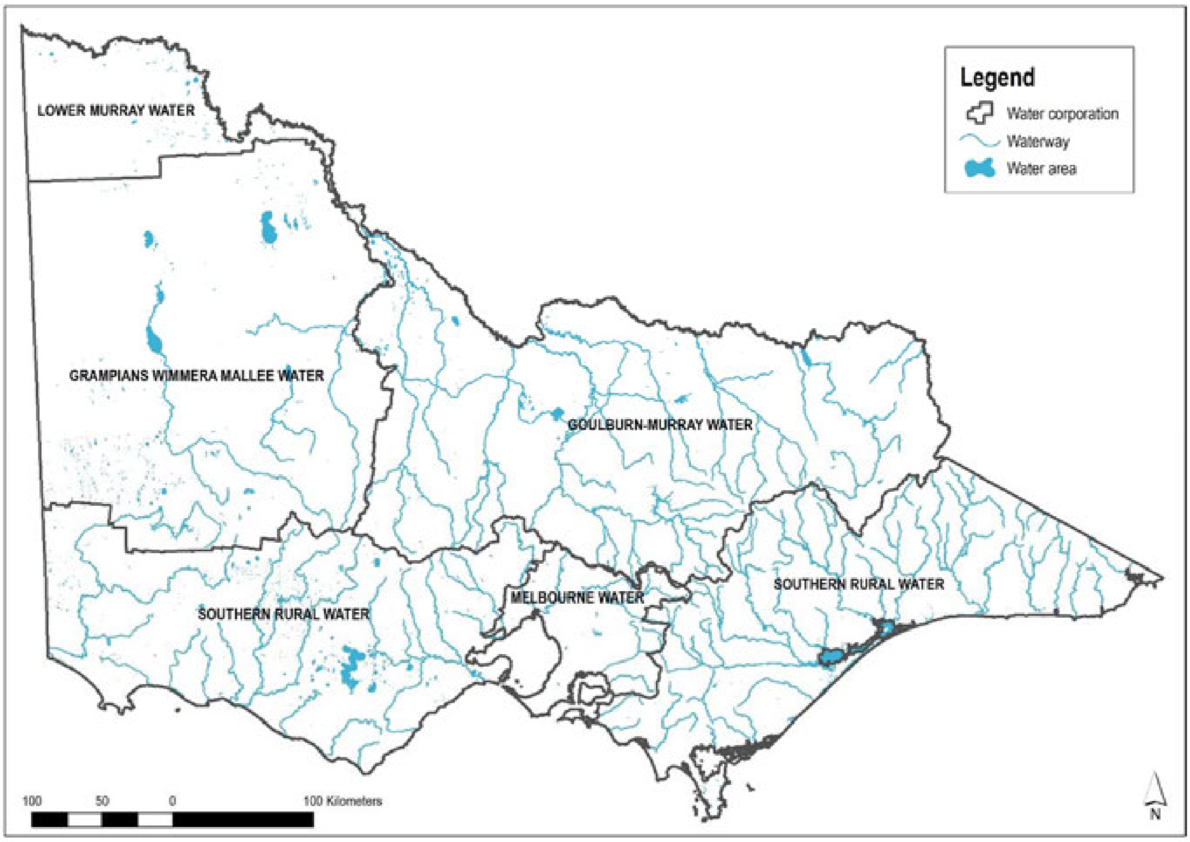
Six **rural water corporations** provide rural water services, including water supply, drainage, and salinity mitigation services for irrigation and domestic and stock purposes. They are:

- Southern Rural Water
- Goulburn-Murray Water
- Coliban Water

- Grampians Wimmera Mallee Water
- Lower Murray Water
- Melbourne Water.

Figure 1-4 shows the rural supply boundaries.

Figure 1-4 Rural supply



Southern Rural Water, Goulburn-Murray Water and Grampians Wimmera Mallee Water are also responsible for:

- providing bulk water supply services to other water corporations in regulated water supply systems in regional Victoria
- managing regulated systems
- administering the diversion of water from waterways
- issuing and administering groundwater licences
- developing and implementing management plans on behalf of the Minister.

Lower Murray Water also administers diversion of water from waterways and issues and administers groundwater licences.

Coliban Water's rural system is for stock and domestic use, and it distributes water across their region via a network of open channel and pipeline systems. Water is sourced for this rural supply from their bulk entitlement to the Campaspe system.

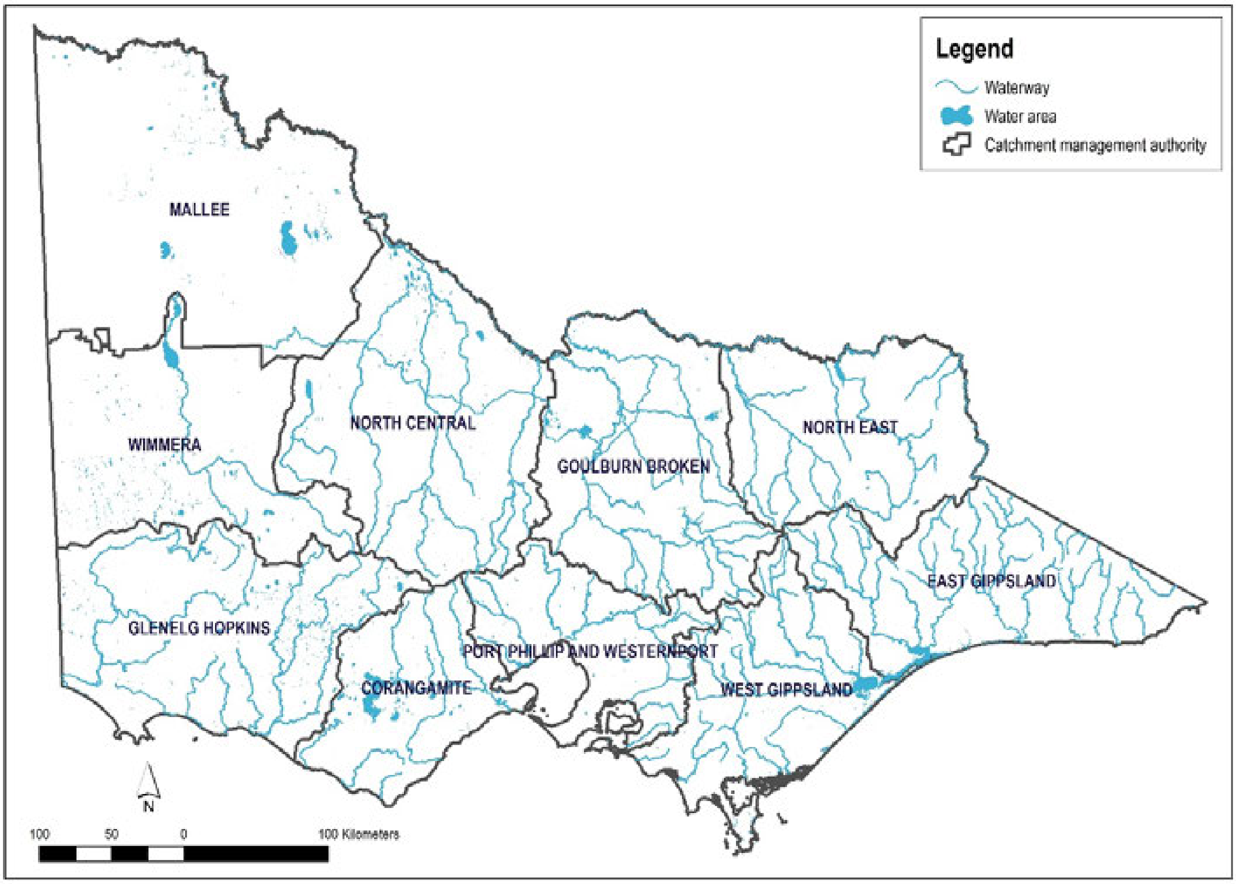
Melbourne Water Corporation provides bulk water supply and sewerage services to water corporations in the Melbourne metropolitan area. Its other responsibilities include:

- managing rivers, creeks and major drainage systems in the Melbourne, Port Phillip and Western Port areas
- developing and implementing management plans on behalf of the Minister
- administering the diversion of water from waterways
- suppling recycled water, through a number of retail water corporations, for irrigation and other purposes

The Victorian economic regulation framework for water, established under the *Essential Services Commission Act 2001* and the *Water Industry Act 1994*, guides water corporation pricing and investment decisions. This economic regulatory framework is overseen by the **Essential Services Commission**. The quality of water supplied by water corporations is independently regulated by the **Department of Health and Human Services** in accordance with the *Safe Drinking Water Act 2003*. The environmental performance of water corporations is independently regulated by the **Environment Protection Authority Victoria** (EPA) in accordance with the *Environment Protection Act 1970*. The EPA is responsible for controlling environmental standards for wastewater discharge.

Victoria's framework for the integrated management of catchments is established under the *Catchment and Land Protection Act 1994* (the CaLP Act). Integrated catchment management is the coordinated management of land, water and biodiversity resources based on catchment areas. It incorporates environmental, economic and social considerations. Victorian is divided into ten catchment and land protection regions (Figure 1-5), each reflecting the unique biophysical qualities of its area. In each region, a **catchment management authority** (CMA) is responsible for the integrated planning and coordination of land, water and biodiversity management, in conjunction with local communities. Under the *Water Act 1989*, CMAs (except for the Port Phillip and Westernport CMA) are also responsible for regional waterway, floodplain, drainage and environmental water reserve management. The CaLP Act establishes the **Victorian Catchment Management Council** as the government's key advisory body on catchment management and the condition of land and water resources at statewide level.

Figure 1-5 Catchment management authorities



The **VEWH** is the independent statutory body responsible for holding and managing Victoria's environmental water entitlements. The VEWH works with CMAs to ensure environmental water entitlements are used to achieve the best environmental outcome with the water that is available. The VEWH holds a number of environmental water entitlements in its own right and manages some entitlements on behalf of the Snowy Recovery and the Living Murray Program.

The **Murray–Darling Basin Authority** is responsible for ensuring compliance with the ***Murray–Darling Basin Plan***, which formally commenced in November 2012. The Basin Plan sets limits on the amount of water that can be extracted from the basin and comes into effect in 2019. These are known as sustainable diversion limits (SDLs). The SDLs are set to recover 2,750 gigalitres of water for the environment. This water will be used to help improve the environmental health of basin rivers, wetlands and floodplains and the habitats of plants and animals that rely on the river system.

1.3 Water entitlement and water resource planning frameworks

The Victorian water entitlement framework (Figure 1-6) sets out the rights of individuals, companies, government and water corporations to take and use water in a system. The key elements of the entitlement framework are:

- secure entitlements with tenure that is certain and protected including bulk entitlements, environmental entitlements, water shares, take and use licences and contractual agreements to supply
- limits on water entitlements: that is, specified volumes, extraction rates and locations, diversion rules and water-sharing arrangements
- the ability to restrict annual water use in response to seasonal variability through seasonal allocations in systems with water shares; rosters, restrictions or bans on licence holders in unregulated surface water and groundwater systems; or water restrictions imposed on urban water customers
- clear, consultative processes before entitlements can be changed
- the ability to trade, using markets to facilitate the efficient movement of water by giving entitlement holders the flexibility to buy and sell entitlements
- private rights enabling individuals to take water for domestic and stock purposes in certain circumstances without a licence
- Traditional Owner rights to water.

To support and guide management of water allocated under the entitlement framework, Victoria's water resource planning framework comprises:

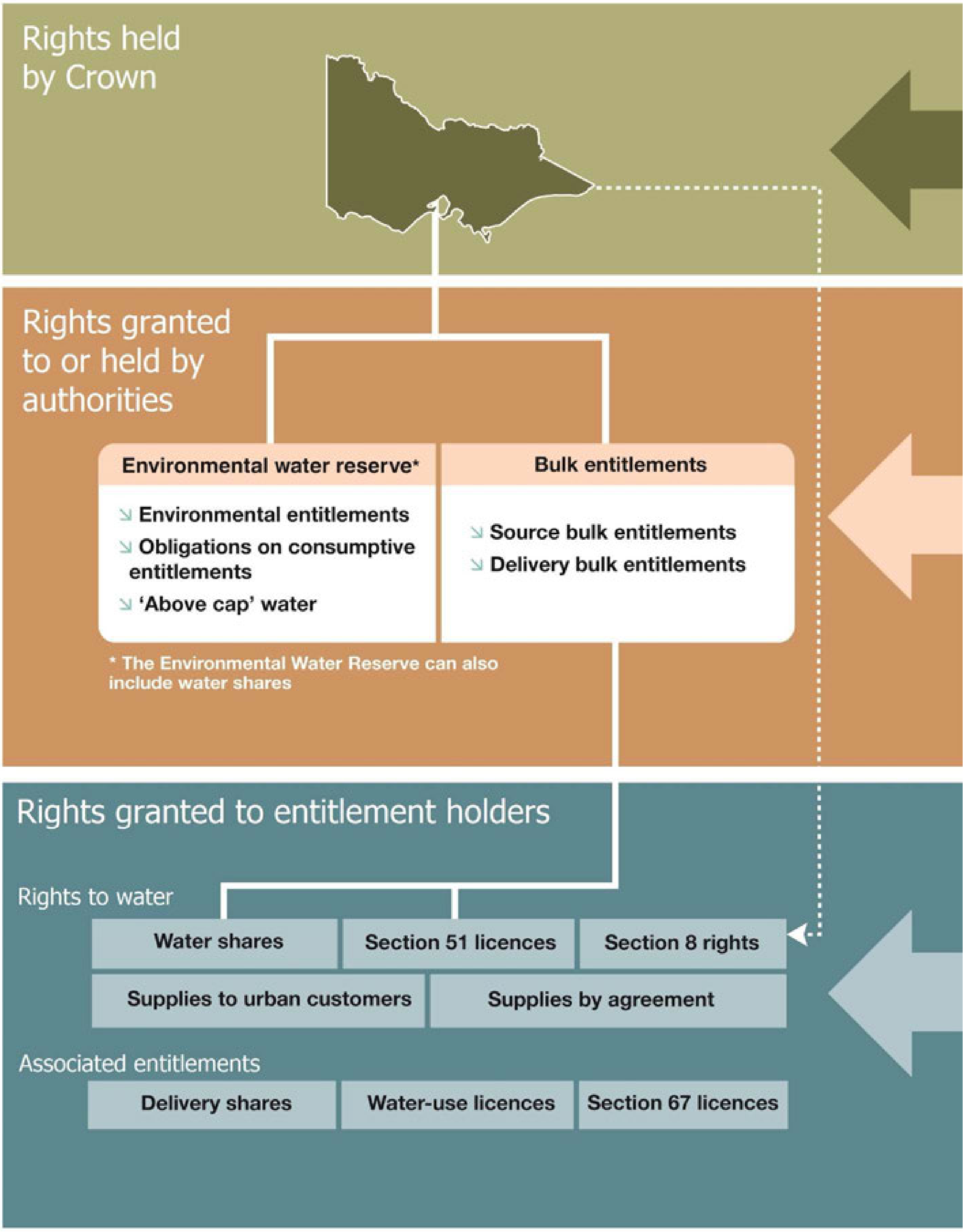
- year-to-year or short-term planning through measures such as seasonal resource determinations on rural regulated systems or drought response plans and annual water security outlooks in urban systems
- local planning to balance the demand of water and available supply in urban areas, through the development of urban water strategies
- statutory management plans for the equitable sharing of available water and long-term sustainability of unregulated surface water and groundwater
- local planning to maintain and improve the health of rivers and wetlands through the development of regional river health strategies every five years
- strategic planning through the development of regional sustainable water strategies (SWSs) every 7 to 10 years
- long-term water resource assessments (LTWRAs) of the resource base and river health every 15 years.

In a first for Victoria, a LTWRA is underway to assess water availability and the health of our waterways. It is a backwards-looking technical assessment to see if water availability has declined and to see if there have been changes in how water has been shared between the environment and consumptive uses, which includes water for farms, industry, cities and towns. It also looks to see whether any changes in the health of our waterways are due to changes in the flow regime. The purpose of the assessment is to identify where Victoria needs to develop solutions to manage the impact of declining water availability and/or deterioration in the health of our waterways.

To prepare for the LTWRA, the Department of Environment, Land, Water and Planning (DELWP) updated previous estimates of long-term surface water availability. For more information about how this has been included in the 2017–18 accounts, see chapter 2.2.

One of the key principles of the water entitlement and water resource planning framework is that entitlement holders are responsible for managing their own water security and risks including during drought.

Figure 1-6 Victorian water entitlements



Water entitlements are defined in the *Water Act 1989* and are issued by the Minister for Water. A water entitlement is the amount of water authorised to be stored, taken and used by a person under specific conditions. Associated entitlements set conditions for water delivery or use.

Environmental water reserve (EWR)

The EWR is the legally recognised amount of water set aside to meet environmental needs. The objective of the EWR is to preserve the environmental values and health of water ecosystems.

Environmental entitlements are generally identical in nature to bulk entitlements. They provide for a share of the available resource.

Obligations on entitlements include the passing flows that water corporations or licensed diverters are obliged to provide out of storage or past a diversion point. The portion of passing flows that is provided to meet environmental needs is considered a part of the EWR.

'Above cap' water includes water that is left over after limits on diversions have been reached and unregulated flows which cannot be kept in storage. Most of the EWR is comprised of 'above cap' water, and this component is most susceptible to climate change.

Bulk entitlements

Held by water corporations with secure tenure in perpetuity. They provide the right to water for system operations, seasonal allocations and other rights and obligations.

Source bulk entitlements provide a share of inflows, storage capacity (if applicable) and releases.

Delivery bulk entitlements provide a set volume of water each year, subject to defined restrictions during periods of water shortages.

Water shares have secure tenure held in perpetuity. A share of the available resource in most regulated systems is allocated annually (through seasonal allocations), which can then be ordered to a specified location, at a specified time and rate.

Section 51 take and use licences allow for diversions from unregulated (and some regulated river systems) and extractions of groundwater. Licences are issued for a specified volume, period of time and with a range of conditions.

Section 8 rights provide for an individual to take and use water from a range of surface and groundwater sources for domestic and stock use under certain circumstances without a licence.

Supplies to urban customers must be provided by water corporations throughout their defined districts.

Supplies by agreement are arranged by water corporations to provide water outside of defined districts, and recycled and drainage water in special circumstances.

Delivery shares provide for water to be delivered to land in an irrigation district via a channel. Delivery shares are linked to delivery infrastructure and stay with the property if the water share is traded.

Water-use licences allow an irrigator to use water to irrigate land up to an annual use limit.

Section 67 licences provide for the construction and operation of a groundwater bore or any works on a waterway, such as a private pump or dam, when a section 51 licence is required.

1.3.1 Water entitlements

Under the *Water Act 1989*, a person may not take water unless they are authorised to do so. Authorisation for the take and use of water is provided under the Act, particularly through the water entitlement framework. The volume of water authorised to be taken and used is specified in a **water entitlement**. A water entitlement is the right to take/use/extract water and may be limited by conditions. Different entitlements are necessary, depending on where and how water is taken and for what it is then used. Water entitlements can be held by an individual, a water corporation, an environmental water holder or another specified body (such as a power company) (Figure 1-6). The conditions of an entitlement do not change based on who owns it.

Water entitlements consider surface water and groundwater resources for both consumptive and environmental purposes at all phases of the water cycle. Consumptive uses include urban, irrigation and industry uses, and power generation. Environmental uses include providing flows within a waterway and diverting flows to wetlands.

The Minister for Water issues water entitlements under the Act. These include:

- section 8 statutory rights
- bulk entitlements
- environmental entitlements
- water shares
- take and use licences.

Statutory rights are provided under sections 8 and 8A of the Act. These rights allow water to be taken without a licence under certain circumstances for specific uses, including:

- **domestic and stock:** under section 8(1) and section 8(4)(c) of the Act, individuals can take water for domestic and stock purposes from surface water and groundwater from a small catchment dam or a bore. The water must be used for the specific purposes set out in the Act.
- **Traditional Owners:** under section 8A of the Act, any member of a Traditional Owner group who has a natural resource agreement under the *Traditional Owner Settlement Act 2010* can take and use water from a waterway or bore for traditional purposes. Traditional purposes means providing for the personal, domestic or non-commercial communal needs of group members.

Bulk entitlements are a right to take and use water in a waterway, water in storage works of a water corporation and groundwater. Bulk entitlements are held by specified authorities (such as water corporations) and are subject to a range of conditions. Appendix D lists the bulk entitlement holders for 2017–18.

Environment entitlements are a right to water granted to the VEWH to improve the environmental values and health of water ecosystems and other uses, depending on the condition of the environment. Chapter 4 reports on environmental entitlements and their use.

A **water share** is a legally recognised perpetual entitlement to a secure share of the water available in a water system. To date, water shares have been issued only for large, regulated river systems with irrigation districts. These are systems with dams or storages that harvest large volumes of water for regulated release to a large number of irrigation customers. Water shares may be high-reliability or low-reliability. The amount of water that may be taken under a water share in any year will depend on the allocation that is made in relation to water shares in that system (see chapter 1.3.2.2). Systems containing water shares are declared and are unbundled (see box below).

A **take and use licence** is issued under section 51 of the Act. It is a fixed-term entitlement to take and use water from a waterway (in unregulated systems), catchment dam or groundwater. Each licence is subject to conditions specified on the licence. Licences are issued and managed in accordance with *Policies for Managing Take and Use Licences (DELWP, 2014)*. These policies set out matters and actions the Minister requires delegates to consider or do.

Chapter 6 and chapter 7 describe the entitlements and use of water taken from river basins and groundwater catchments. Chapter 8 then describes the movement of this water through the constructed distribution systems that deliver water to users.

Victorian water entitlements are recorded in the *Victorian Water Register*, which provides an authoritative record of the entitlements, water available as carryover and associated transactions including allocation and trade. Useful information for water users about water entitlements, seasonal allocations, trade and transfers can be found on the Victorian Water Register website, waterregister.vic.gov.au.

For more information about Victoria's entitlement framework visit the DELWP Water website: https://www.water.vic.gov.au/planning-and-entitlements/victorias-entitlement-framework.

Water systems may be **declared** in accordance with section 6A of the Act.

In declared water systems, entitlements previously called water rights and take and use licences (with some specific exceptions) have been separated, or ‘unbundled’, into four separate elements. These are a **water share**, a **delivery share** (or ‘extraction share’ in a works licence), a **water-use licence** or **a water-use registration**.

A **water share** is the legally recognised, perpetual entitlement to a secure share of the water available from a declared water system. Water shares may be high-reliability or low-reliability. A water share is an entitlement to a share of the available water. Seasonal resource determinations specify the percentage of a water share that is available annually.

A **delivery share** is an entitlement to have water delivered to land. It gives access to a share of the available capacity in a channel or piped network that supplies water to a property. A delivery share is tied to the land and stays with the property if it is bought or sold. It also stays with the property if the water share is sold separately.

A **water-use licence** is an entitlement to irrigate a specific parcel or parcels of land. The licence sets out the conditions for use (such as how much water you can use on your land in a single irrigation season). Water-use licences are required for irrigation from the regulated Murray, Goulburn, Broken, Loddon, Campaspe, Bullarook, Werribee or Macalister systems.

A **water-use registration** is similar to a take and use licence but has no fixed term. It authorises take and use from a dam, spring or soak. It is attached to the land and cannot be traded, except on sale of the land. It can however be converted into a take and use licence. Registration licences were able to be issued for one year, between 1 July 2002 and 30 June 2003 and were based on historical water use.

Most of the state’s regulated water systems have been declared.

The regulated systems in northern Victoria were declared on 1 July 2007. These are the Broken, Bullarook, Campaspe, Goulburn, Loddon, Murray and Ovens systems.

The Werribee and Bacchus Marsh and Thomson–Macalister water systems in southern Victoria were declared on 1 July 2008.

1.3.2 Managing resources and responding to water availability

All water resources are managed in accordance with the Act and statewide policy. As mentioned in chapter 1.2, rural water corporations are responsible for managing regulated and unregulated systems.

In regulated water systems, rural water corporations manage the available water resource, with delegated responsibilities for administration of entitlements and planning. They:

- plan for the management of their systems to supply the specified entitlements
- develop low-flow contingency plans for managing severe water shortages
- provide regular information to entitlement holders to assist with their planning.

Planning in unregulated surface and groundwater systems generally involves developing management arrangements so that available resources are managed equitably and sustainably. The management plans may include such things as triggers for rosters, restrictions and bans on extractions during low-flow periods, trade rules, metering, monitoring and reporting requirements.

Most Victorian water supply systems also have a **cap** or a limit placed on the total amount of water that can be taken from a system within a given timeframe, typically one year. Effectively, these caps limit the issue of entitlements in these systems so that water allocation and diversions do not:

- impact on the resource and on access to the resource for other entitlement holders
- impact on important environmental values
- exceed the cap or limits on take from a resource.

In 2012, the Victorian Government developed a framework for the management and reporting of groundwater resources. The groundwater management and reporting framework comprises groundwater regions, groundwater catchments and groundwater management units (GMUs). It includes:

- **groundwater regions**: the largest scale of connected hydrogeological resources, from highlands to sedimentary plains. This is also the scale of water resource plans for groundwater under the Basin Plan
- **groundwater catchment**s: the longitudinal flow path of connected groundwater resources, which are interconnected laterally within a region
- **GMUs**: defined areas where specific rules are used to manage the resource according to the needs of groundwater users and the environment. There are two types of GMUs: water supply protection areas (WSPAs) and groundwater management areas (GMAs):
    - **WSPAs**: areas declared to protect groundwater or surface water resources through the development of statutory management plans

- o **GMAs**: defined for the purposes of management, most commonly areas where no new groundwater entitlement is available. They may be intensively developed, or have the potential to be.

There were several changes to GMUs in 2017–18 (chapter 3.2).

Further details about the groundwater management framework in Victoria are available at https://www.water.vic.gov.au/groundwater/managing-groundwater.

Rural water corporations are responsible for managing groundwater. Rural water corporations are constantly reviewing management arrangements, to ensure objectives are being met and to respond to changing climate, knowledge, use and legislation. Water corporations are also gradually working towards management on a catchment scale to reflect connected resources, reduce costs and achieve better environmental outcomes.

Lessons from the Millennium Drought

Between 1996 and 2010, Victoria experienced unprecedented dry conditions – a period now known as the Millennium Drought. These 13 consecutive years of drought, including the lowest annual inflows to storages recorded (2006–07), resulted in conditions well outside the boundaries within which water supply systems and water-sharing rules across Victoria were designed to operate. By the 2006–07 summer, many areas faced severe water shortages. These shortages were more extreme than envisaged possible when water entitlements were developed, and the effectiveness of Victoria's water management frameworks was tested.

Despite water managers' efforts to adapt to the unprecedented conditions, water-carting was required to maintain essential water supplies for several towns and rural supply systems. Major infrastructure projects were brought forward, irrigation allocations were the lowest on record and the Minister for Water was required to declare water shortages and temporarily qualify rights to water because existing water-sharing arrangements had failed. In many rivers across Victoria, the environment was disproportionately impacted, compared to consumptive users. This occurred because most of the environmental flows were sourced from unregulated flows or spills from storage, which ceased during the drought, rather than secure entitlements that received a share of the limited water available.

The unprecedented nature of the Millennium Drought, particularly its length and severity, motivated and accelerated several responses to water scarcity including:

- major policy and planning initiatives (for example, SWSs)
- infrastructure upgrades (for example, the Wimmera Mallee Pipeline Project and Goulburn-Murray Water Connections Project)
- augmentations (for example, the Goldfields Superpipe)
- improved system management.

It should also be noted that a major water reform was implemented across northern Victoria in July 2007 and southern Victoria in July 2008: the unbundling of water rights from land to create water shares. This reform was unrelated to the drought, but made the water market more accessible to individuals and water corporations during its last few years.

Significant hardship was endured during the Millennium Drought, but several positive outcomes were achieved that enable Victorian water managers to better manage water resources into the future. They included:

- amendments to entitlements to incorporate sharing arrangements for dry conditions
- clearer entitlements for the environment and more-efficient use of water for the environment
- reserve rules that reduce the likelihood of years with zero allocation (in large, regulated systems)
- improved flexibility and options through measures such as trade and carryover
- streamlining of water-trading options to enable water to move from low- to high-value uses
- creation of new and alternative sources
- a modernised and reconfigured irrigation system.

The Millennium Drought has highlighted that planning and system design cannot be based on the assumption that climate is a stationary phenomenon. While unplanned measures were necessary to respond to the unprecedented conditions, the experience of managing through the Millennium Drought has served to reinforce the relevance of Victoria's water entitlement and water resource planning frameworks and principles.

The uncertainty surrounding future conditions means that planning needs to be based on a wide range of plausible future climate scenarios. Guidelines for urban water supply demand strategies, developed after the drought, emphasise scenario planning and adaptive management to ensure urban water supply security in the medium to long terms.

Responding to water availability

The amount of water available for consumptive use and environmental purposes will vary from year to year. The entitlement and planning frameworks include mechanisms to conserve and share water between users in response to seasonal variability and water shortages. These mechanisms include:

- urban water restrictions
- seasonal allocations in regulated systems
- restrictions on licence holders in groundwater systems and unregulated surface water catchments.

When these mechanisms for managing the variability of water availability are not sufficient, water corporations may also undertake other measures (such as water-carting) to augment local supplies. Any water-carting undertaken in 2017–18 will be reported in chapter 2.5.5.

The Minister for Water also has powers under section 33AAA of the Act to declare that a water shortage exists and to temporarily qualify rights to water. Temporary qualification of rights is a measure of last resort to be used during unforeseen and emergency events. Temporary qualification of rights results in a temporary change in water-sharing arrangements in a specified area to ensure critical water needs are met under these circumstances. Rights to water that may be qualified include licences, water shares, bulk entitlements and environmental entitlements. Chapter 2.5.6 documents any temporary qualification of rights that occurred during 2017–18.

To facilitate the efficient use of water resources in Victoria, water can be traded between users and locations in accordance with trading rules, which are designed to protect third parties from unacceptable impacts. Water markets and trading water are important mechanisms for individual entitlement holders to manage seasonal variations in water availability, and they facilitate the sharing of available resources. Chapter 5 reports on water trade in 2017–18.

1.3.2.1 Urban water restrictions

As described in chapter 1.3, in line with the water resource planning framework water corporations undertake short-term and long-term planning to balance the demand of water and available supply and plan for the year ahead.

Water corporations develop long-term urban water strategies to support the development of resilient, liveable communities as well as to balance social, environmental and economic costs and benefits across the environment, agriculture, towns and businesses.

Each year on 1 December, water corporations also publish an annual water outlook. Outlooks report on the current condition of each water supply system including storage positions and predicted future water availability, and they outline strategies to meet customer demand over the next 12 months. Outlooks also indicate the likelihood of urban water restrictions under different climate scenarios.

All Victorian towns are subject to a uniform scale of water restrictions under the Victorian Uniform Drought Water Restriction Guidelines. The scale has four stages of restrictions, with increasing levels of severity as water shortages become more severe. While water corporations can tailor the restrictions under each stage to suit local conditions (that is, by providing exemptions), the nature of restrictions are consistent across the state. The trigger points for each stage of water restrictions are outlined in the drought response plan of each water corporation. These plans also include contingency measures for temporary water supplies or savings beyond stage 4. Each urban water corporation also has permanent water-saving rules which apply at all times and set basic conditions for water use when water restrictions are not in place.

Chapter 2.5.1 documents urban water restrictions in place during 2017–18.

1.3.2.2 Seasonal allocations in regulated systems

The volumes of water available for use in some regulated systems are determined by the seasonal allocation process. This process differs from urban restrictions in that each water entitlement is allocated a share of the available water resource in proportion to the entitlement volume. Seasonal allocations are expressed as a percentage of entitlement. (which can have differing levels of reliability, termed either high-reliability or low-reliability entitlements).

Seasonal allocations are determined for each system using a water budget. The water budget calculates how much water is currently in storages and is expected to flow into them over a specified period, to decide how much water can be allocated to entitlement holders in that system. Allocation policies vary between supply systems, and in some cases there is a reserve policy, which means once allocations reach a certain level some water starts to be set aside for the following year. Opening seasonal allocations can be low, particularly in systems where there is no reserve policy, but the water budget is reviewed by rural water corporations throughout the year and seasonal allocations are increased as more water becomes available. In declared systems, this process is called a seasonal determination.

Goulburn-Murray Water is the Northern Victorian Resource Manager appointed by the Minister for Water and has been given responsibility for making the seasonal determination for all northern Victorian declared water systems. Southern Rural Water also has responsibility for announcing seasonal allocations in their declared water systems.

Chapter 2.5.2 documents the 2017–18 seasonal allocations in regulated systems.

1.3.2.3 Restrictions on licence holders in unregulated systems

Statutory management plans and local management plans set out how water in unregulated streams will be shared between consumptive uses and the environment. Streamflow and/or groundwater statutory management plans are prepared to manage the unregulated surface water and/or groundwater resources of the area. (Non-statutory) local management plans advise how the water corporation is managing resources outside a WSPA.

Under statutory plans, water corporations may impose rosters, restrictions and bans on the water taken from streams by licensed diverters when streamflows drop below specified thresholds. Rosters and restrictions set out the order in which licence holders may take water and the quantity allowed to be taken (for example, 75% of licensed volume). When water is particularly scarce, bans on diversions from waterways are imposed.

The need to implement restrictions on diversions from unregulated streams fluctuates during the course of the year, depending on rainfall and streamflows. Restrictions and bans are usually most severe in summer and autumn and are more likely to be eased over the winter and spring seasons. Victoria now only issues winterfill licences that permit take between the months of July and October.

Chapter 2.5.3 documents restrictions on diversions from unregulated streams in 2017–18.

Groundwater licences are all-year licences. Management plans for some GMUs may include levels that will trigger the introduction of a restriction that will reduce the volume water users can take under their licence.

A management plan may include restrictions to:

- reduce the risks from falling groundwater levels (risks can include reduced access in other licensed bores or domestic and stock groundwater supply, impacts on groundwater-dependent ecosystems and potential long-term irreversible impacts on the quality of the resource)
- allow the resource to be shared between all users
- recognise and reduce the social and environmental costs of lowering groundwater levels.

Chapter 2.5.4 reports on groundwater restrictions in 2017–18.

1.4 Monitoring and reporting

Local factors influence how much rainfall flows into streams and recharges groundwater aquifers. These factors include subsurface geology, soil permeability and moisture levels, vegetation cover and the pattern of individual rainfall events. Victoria has an extensive network of monitoring sites that record information about rainfall and temperature, river quantity and quality, groundwater levels and quality, and the production and quality of recycled water. The amount of water that is taken from rivers and groundwater is also monitored, and use is metered wherever practical.

Surface water and groundwater

Information gathered through monitoring enables us to make informed water resource management decisions. In Victoria, data is collected from about 1,400 groundwater sites from the State Observation Bore Network and about 780 surface water monitoring sites under Victoria's Regional Water Monitoring Partnerships program. The partnership approach allows data to be collected to a well-defined standard once, then used for multiple business needs such as:

- availability and allocation management
- quality and compliance monitoring
- flood warning
- water resource assessment
- river health management
- linkages between groundwater and surface water systems.

The partnerships provide a coordinated and efficient approach to the statewide collection of information required for delivering a continuous program of water resource assessment for Victoria, as required under the *Water Act 1989*. About 40 organisations invest in the program, and DELWP acts as both a partner and overarching program manager.

The **Bureau of Meteorology** (BoM) is Australia's national weather, climate and water agency. The BoM provides observational, meteorological, hydrological and oceanographic services and undertakes research into science- and environment-related issues in support of its operations and services. The BoM monitors rainfall and evaporation across Victoria. It is also one of the 40 partners involved in the Regional Water Monitoring Partnerships program. Chapter 2.1 reports on rainfall across the state in 2017–18. Evaporation and rainfall in each basin is reported in each of the river basins throughout chapter 6.

In Victoria, the EPA oversees the quality of recycled water, and the 16 urban water corporations monitor the production and use of recycled water.

All of the water sector organisations mentioned in chapter 1.2 report annually on their operations and functions during the financial year. A lot of the information published in these reports and the monitoring data mentioned above is also used in the accounts, to report on Victoria's water resources each year.

2. Water availability

This chapter presents an overview of surface water and groundwater availability in Victoria in 2017–18. It reports rainfall, streamflows and levels in major reservoirs, compared to previous years and the long-term average. It also reports the annual trend in groundwater levels in groundwater catchments and the management responses to water availability in 2017–18.

The following were the key water availability events in 2017–18.

- Conditions in 2017–18 were drier than the previous year, with below-average rainfall received across most of Victoria throughout the year. The below-average rainfall in July 2017, following a record dry June, gave Victoria its second-driest start to winter on record (after 1982). Rainfall during September was below to very much below average over much of Australia, and the lowest on record for the Murray–Darling basin as a whole (chapter 2.1).
- Warm temperatures and low rainfall experienced from January to July 2018 increased the impact of drought in eastern Australia.
- A short-lived, weak La Niña event began in December 2017 and ended in March 2018 (chapter 2.1).
- Overall, 61% of long-term annual average streamflows were received in Victoria, with all 29 river basins receiving lower annual average streamflow volumes than those received in 2016–17 (chapter 2.2).
- Although storages ended the year lower than they began, 28 of Victoria's regional storages reached at least 90% of capacity by September 2017, and four reached full capacity and were spilling (chapter 2.3).
- Groundwater level trends in 2017–18 were similar to those in 2016–17 (chapter 2.4).

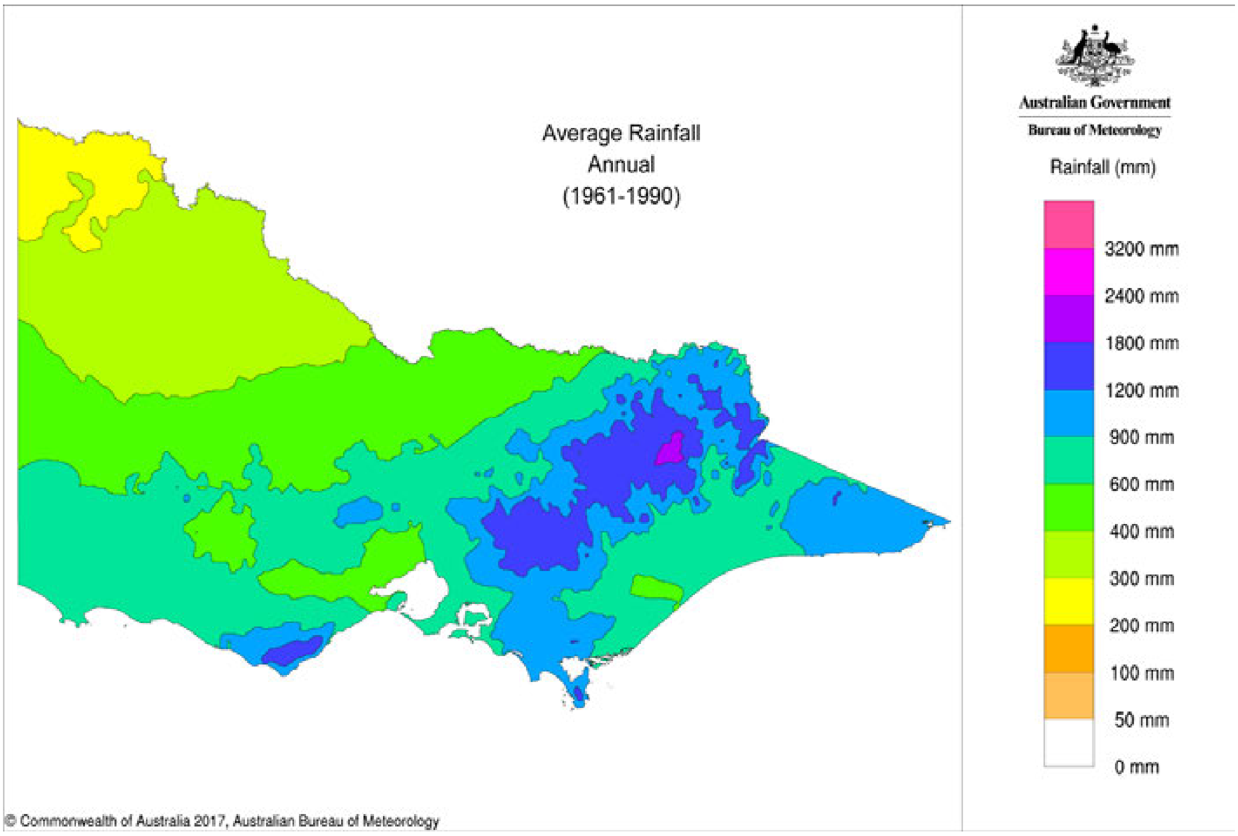
Restrictions and allocations were similar to the previous year in 2017–18:

- only one town was on urban water restrictions in 2017–18, the same as in 2016–17 (chapter 2.5.1)
- all high-reliability entitlements received 100% allocation in regulated systems except the Werribee and Bacchus Marsh district, compared to all systems in the previous year (chapter 2.5.2)
- there were 130 streams subject to restrictions on diversions in March 2018, compared to 94 at the same time in the previous season (chapter 2.5.3).

2.1 Rainfall

Long-term average rainfall in Victoria varies from less than 300 mm a year in the north-west of the state to 2,400 mm a year in the Alpine area of the north-east (Figure 2-1).

Figure 2-1 Victorian long-term average annual rainfall, 1961–90



Although the 1961–1990 long-term average is used throughout the accounts, the Millennium Drought highlighted that planning and management cannot assume that climate will always remain the same (chapter 1.3.2). Victoria's climate has shown a warming and drying trend over recent decades, and this trend is expected to continue. Compared to historical conditions, we are already experiencing:

- higher temperatures, particularly during the warmer months of the year
- reductions in rainfall in autumn and early winter, and in some locations increases in rainfall during the warmer months
- in some catchments, less streamflow generated for the same amount of rain.

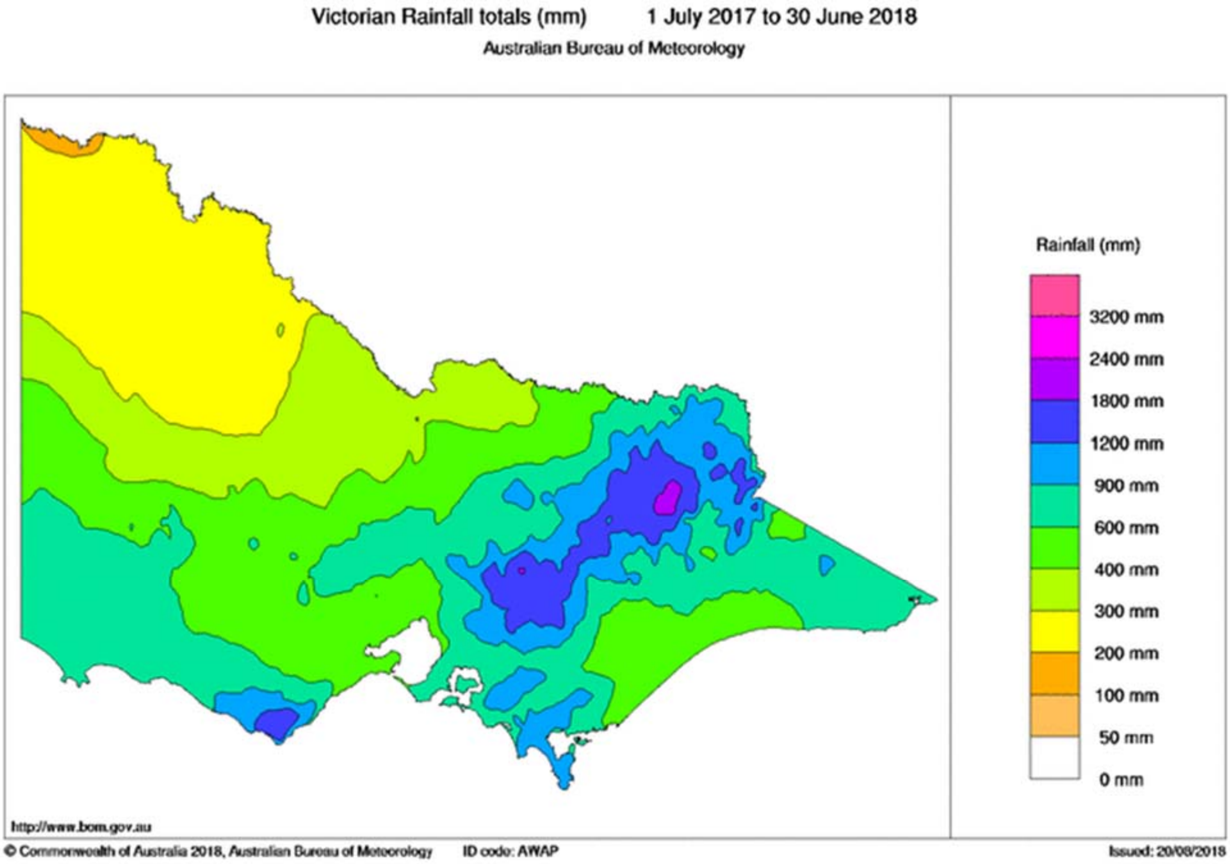
As part of implementing *Water for Victoria*, the Victorian Government is investing in further research to better understand how Victoria's climate is changing and the water resource implications. DELWP is working with the Bureau of Meteorology to incorporate the climate trends from the last two decades into a new assessment of the current climate.

The 2017–18 year began with a neutral tropical Pacific Ocean (neither El Niño nor La Niña conditions). The Bureau of Meteorology activated a La Niña watch in October 2017, due to a cooling Pacific Ocean. La Niña conditions were later confirmed in December 2017. The event ended in March 2018 and was considered to be weak and short-lived. It had little effect on Australian rainfall patterns, but it may have kept temperatures higher than average in the south of the country. The Pacific Ocean remained neutral for the remainder of 2017–18, however an El Niño watch was issued in June 2018.

In contrast to the average and above-average rainfall received in most of Victoria in the previous year, rainfall in 2017–18 was average to very much below average, a pattern that was widely observed across south-east Australia. Temperatures were above average for most of the state during 2017–18, except in winter when Victoria experienced its coolest winter nights since 2006.

The range for total annual rainfall varied from 50 to 300 mm in the north-west, from 300 to 600 mm in the central-west and up to 900 mm in some areas along the south-west coast and in east Gippsland. From 900 to 1,800 mm was received in the Alpine, south Gippsland and Otway regions, with a small area near Falls Creek and Marysville receiving up to 2,400 mm (Figure 2-2).

Figure 2-2 Victorian rainfall, 2017–18, millimetres

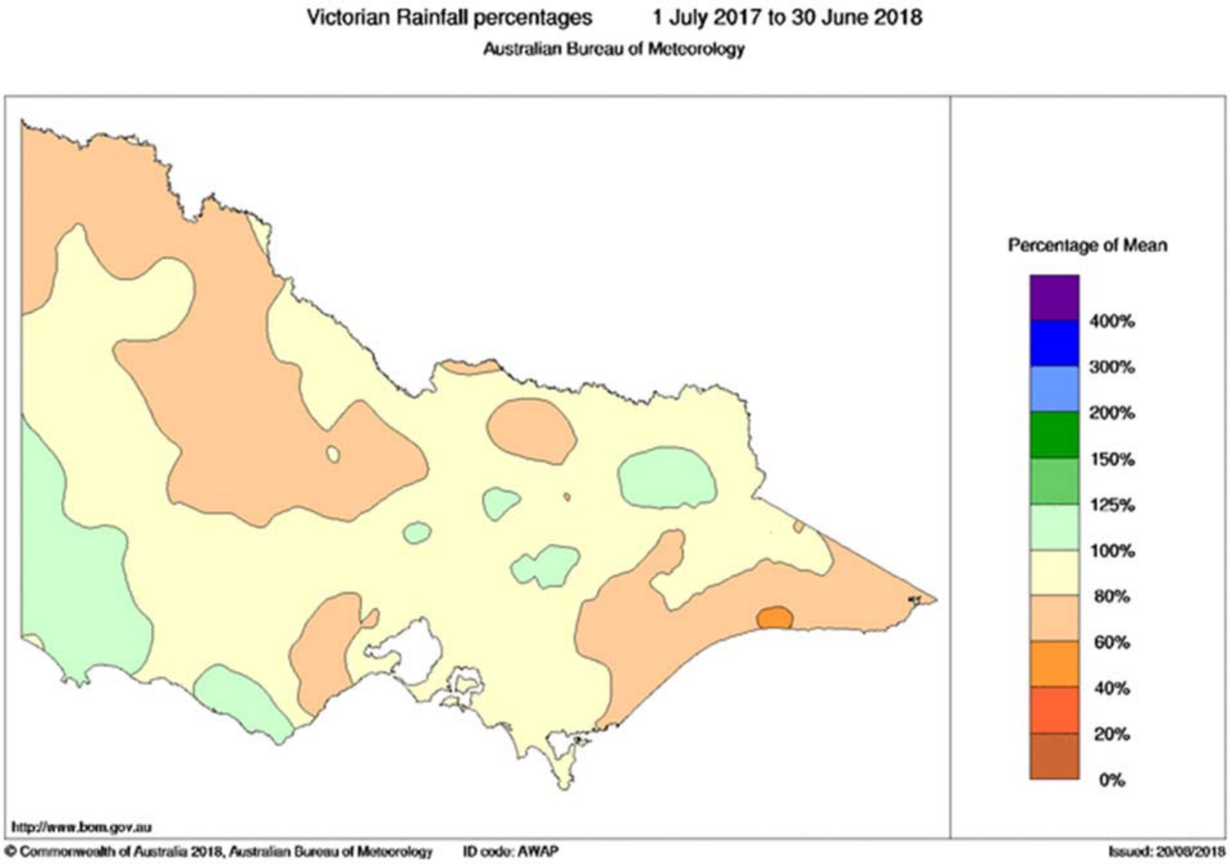


Annual rainfall across Victoria was typically between 60% and 125% of the average (Figure 2-3). Above-average rainfall was received in the south-west and in parts of the Alps (such as the upper Kiewa and Goulburn rivers). The south-central and middle regions of the state typically received average rainfall. Below-average rainfall was received in the north-west and in Gippsland. The greatest rainfall anomalies were recorded in Gippsland, parts of the Alpine National Park and the Otway Coast near Wye River. These regions received an annual rainfall that was between

200 mm and 400 mm below average. According to Bureau of Meteorology definitions, there was a serious deficiency and a severe deficiency of rainfall in parts of Gippsland in 2017–18.

Averaged across Victoria as a whole, evapotranspiration in 2017–18 was estimated to be 507 mm. This is about 17% below the long-term (1961–90) average evapotranspiration rate. The difference between the long-term average and modelled evapotranspiration for 2017–18 was greatest in the Kiewa, Portland Coast and Otway Coast basins, where evapotranspiration was between 4% and 9% higher than the long-term average. Evapotranspiration as a proportion of the long-term modelled average was least in parts of Gippsland and in the north-west, which experienced below-average rainfall in 2017–18. These areas received rates of modelled evapotranspiration that were up to 21% below the long-term average. Across most of the state, evapotranspiration represented a greater-than-average proportion of rainfall. As a result, less rainfall flowed into streams and recharged groundwater aquifers than would be the case in an average year (Appendix A).

Figure 2-3 Victorian rainfall, 2017–18, as a percentage of long-term average rainfall



In 2017–18, seasonal patterns of observed rainfall in Victoria were consistent with the trends from recent decades of decreased rainfall in the cool seasons and increased rainfall in the warm seasons. Higher temperature anomalies were also observed. Seasonal averages of typically up to 2° C above average were observed in spring, summer and autumn, and cooler-than-average temperatures were observed in winter 2017.

In 2017, Victoria experienced its driest winter since 2006, unlike in 2016 when rainfall was above the 30-year average for much of Victoria. Rainfall was below average across most of the state, and very much below average across the central and south-eastern districts. Parts of the western districts saw near-average rainfall (Figure 2-4A). Temperatures were generally warmer for most of the state, and nights were cooler.

Victoria in spring 2017 was drier than average in the east but was close to average or wetter than average in the west (Figure 2-4B). Above-average rainfall was received along the south-west coast, and rainfall was very much below average in south-east Gippsland. Daytime and nighttime temperatures were much warmer than average, with Victoria recording its fourth-warmest spring on record. A new September high was set for Victoria in Mildura on 23 September, when temperatures reached 37.7° C. During November 2017, Victoria also experienced an unusually long run of warm days and nights.

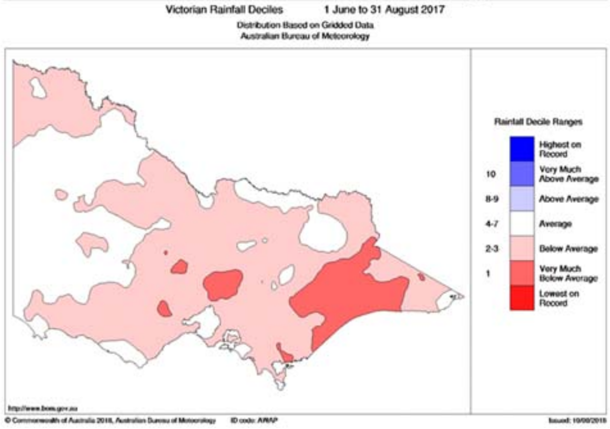
After the record wet start to summer 2017–18, the season ended with drier-than-average conditions in February. For the season, below and very much below-average rainfall was received in the west, and above-average rainfall was received in the east (Figure 2-4C). Many of the Bureau of Meteorology's rainfall sites, including seven with over 100 years of data, had their highest summer daily rainfall on record from the rain event at the start of December, and most daily records were broken on the 2nd. During this event, Victoria State Emergency Service received 2,700 calls for assistance across Victoria, with crops and homes in the north-east and parts of Melbourne affected by flood waters. Severe thunderstorms also extended eastwards across most of central and east Victoria during the afternoon and evening of 19 December, bringing with them more flash flooding, damaging winds and hail stones up to 5 cm in diameter.

Average daytime and nighttime temperatures were very much above average across much of the state over summer. Nights were especially warm: it was Victoria's third-warmest summer on record in terms of minimum temperatures.

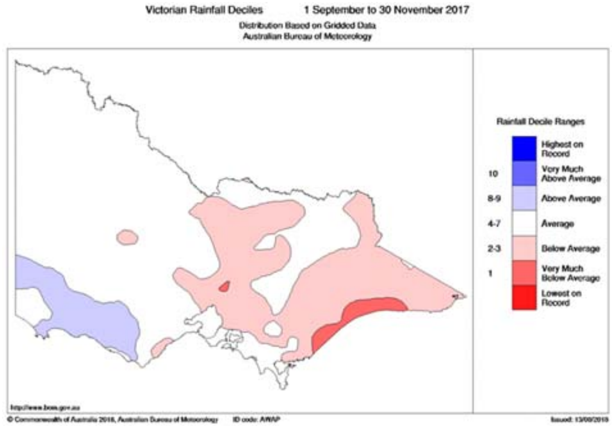
Autumn 2018 was much drier and warmer than the previous year, with the lowest rainfall received since 2008. It was the fourth-warmest autumn on record. Rainfall was below average over most of Victoria, with well-below-average rainfall in large areas in the north and east of the state (Figure 2-4D). Mean daytime temperatures were well above average across Victoria, with many sites (mostly in the north) having their highest autumn mean daily maximum temperature on record. Weather records were also broken in April during a long, spatially extensive, hot weather event that was more characteristic of the summer season.

Figure 2-4 Victorian seasonal rainfall deciles, 2017–18

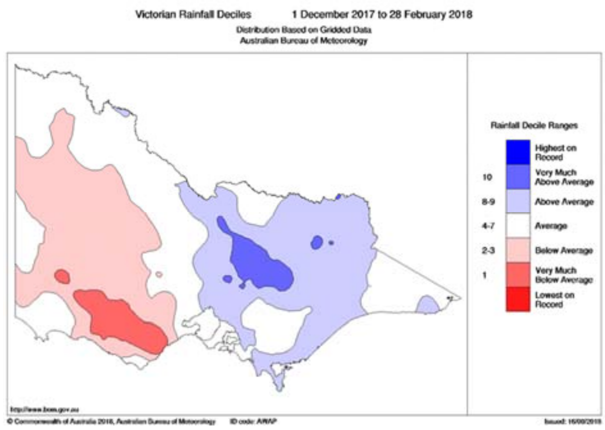
A. Rainfall deciles for winter 2017 (June–Aug)



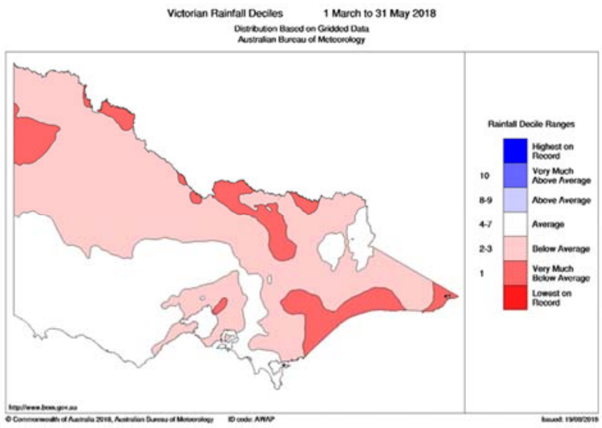
B. Rainfall deciles for spring 2017 (Sept–Nov)



C. Rainfall deciles for summer 2017–18 (Dec–Feb)

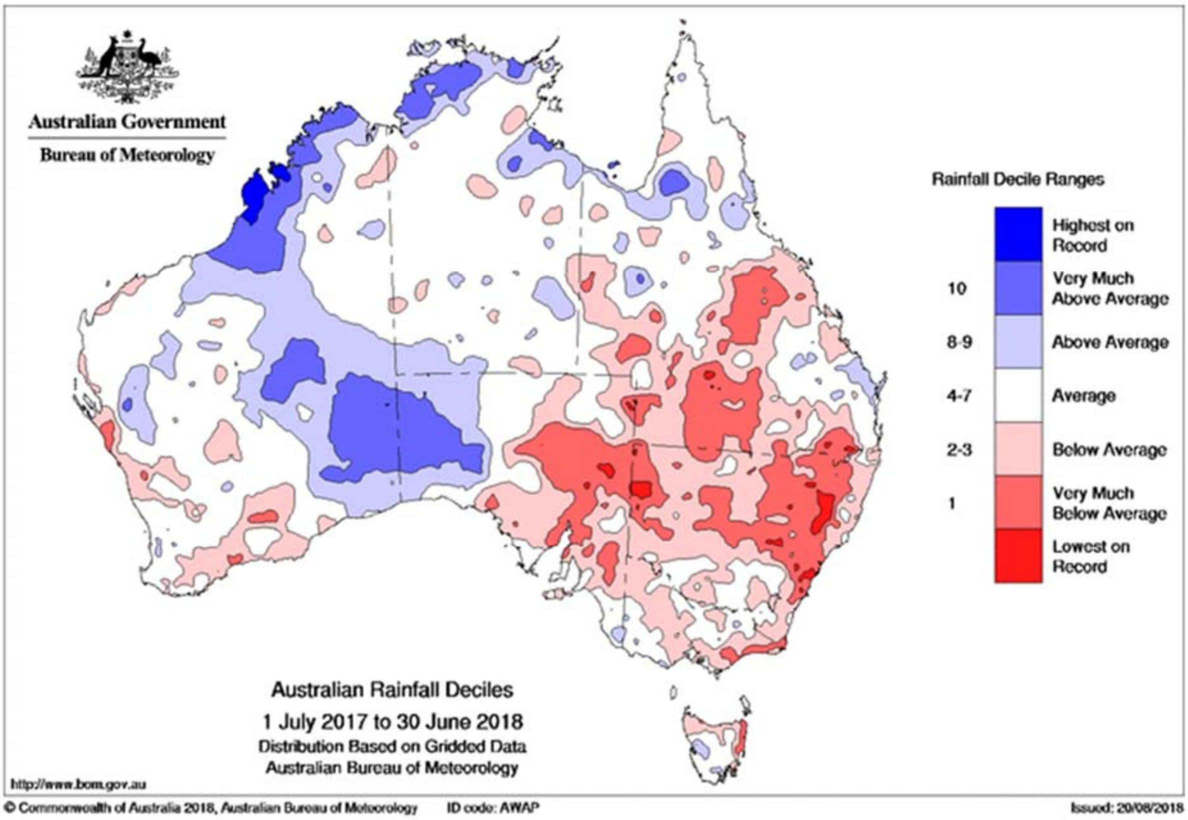


D. Rainfall deciles for autumn 2018 (Mar–May)



Overall, most of Victoria received average rainfall in the south-west and parts of the north and below-average rainfall elsewhere in 2017–18. A similar trend was observed in the coastal regions of Western Australia. Below-average rainfall was received in much of Queensland, South Australia and New South Wales. Large areas of New South Wales, agricultural and the east pastoral regions of South Australia, southern coastal Western Australia, Gippsland and north-east Tasmania received very much below-average rainfall. Above-average rainfall was received in Western Australia and northern Australia, with areas near Broome and Kimbolton in Western Australia receiving the highest rainfall on record. (Figure 2-5).

Figure 2-5 Australian rainfall deciles, 1 July 2017 to 30 June 2018



2.2 Streamflow

In these accounts, streamflow is equivalent to 'catchment inflow' in the water balances presented in chapter 6. Streamflow in waterways can vary between months. It provides an assessment of surface water availability by river basin.

2.2.1 Review of long-term surface water availability

As explained in chapter 1.3, SWSs and LTWRAs are important components of the water resource planning framework. SWSs guide strategic planning every seven to 10 years, and LTWRAs are completed every 15 years to assess the resource base and river health.

Long-term surface water availability numbers used in previous accounts have mostly come from those estimated when preparing the SWSs from 2006 to 2011. At that time, long-term water availability for a basin was estimated as the average annual volume of water available over the entire period for which historical data for measured or modelled streamflow was available for that basin.

Since the original SWS estimates of water availability were made, there have been improvements to the data and methods for calculating water availability. As part of the current LTWRA, a technical assessment was undertaken in 2019 to identify any changes in surface water availability. Through the technical assessment, the LTWRA refined the original SWS estimates using the improved data and methods, and it provided an updated estimate of long-term water availability for use in the accounts (see Table 2.1). Along with the improved methods and data, the updated estimate of long-term surface water availability also updates the modelling time period to better represent our current climate conditions, while still capturing a wide range of historical natural climate variability.

Consistent with state government climate change guidelines (DELWP, 2016), the period from 1975 to the present is considered more representative of climate under current levels of greenhouse gas concentrations than the longer-term historical record. This is supported by the latest research from the Victorian Climate Initiative[2], which shows that current climate conditions are different from earlier decades of the 20th century. The post-1975 period is also sufficiently long to capture a wide range of natural climate variability, including both very wet and very dry sequences of years, that a more recent shorter period would not. Importantly, the period used includes all of the Millennium Drought, several recent major floods and ongoing shifts in seasonal rainfall patterns. Not all of these were captured in the SWS estimates of water availability.

For 2017–18, these new estimates of long-term water availability (**new** long-term average annual streamflow) have been used for all except five basins. The **new** long-term average (LTA) inflows figure has not been applied in the

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[2] Hope, P, Timbal, B, Hendon, H, Ekström, M, Potter, N. 2017. A synthesis of findings from the Victorian Climate Initiative (VicCI). Bureau of Meteorology, 56 pp, Australia

Bunyip, Corangamite, Glenelg, Otway Coast and South Gippsland basins. The gauges used in these five basins to determine the LTAs are different to those used to calculate the total inflows in 2017–18. The **old** long-term water availability estimate (**old** long-term average annual streamflow) has been applied in these accounts. Further work will be completed for these basins to update the estimates in future accounts.

2.2.2 Streamflow in 2017–18

In 2017–18, all 29 river basins had annual streamflow volumes lower than those received in 2016–17 (Table 2-1). When compared to the **new** long-term annual average streamflows, four basins had above-average streamflows for 2016–17, compared to the previous year when 21 basins had above-average streamflows. Overall, the total annual streamflow volume for Victoria was 13,968,960 ML (61% of the **new** long-term average or 53% of the **old** long-term average) (Table 2-1). This is more than half the volume received in 2016–17, which was 30,896,294 ML (135% **new** long-term average or 118% of the **old** long-term average).

Compared to last year, there was much less rainfall in 2017–18 across most of the state, which meant less rainfall flowed into streams. Victoria had its driest winter since 2006, and spring was drier than average in the east but close to average or wetter than average in the west. The south-west coast received above-average rainfall, and rainfall was very much below-average in the east.

As a result, all of the usually wet basins in the east of the state (East Gippsland, Tambo and Snowy) received below-average streamflows, and all of them had a reduction in streamflow compared to 2016–17. The Mitchell, Latrobe and Thomson basins all received 54% (Mitchell), 59% (Latrobe) and 60% (Thomson) of the **new** long-term annual average. As explained in chapter 2.2, the **old** long-term annual average has been used to compare the Bunyip and South Gippsland basins, which received 76% and 88% respectively of the **old** long-term annual average inflows.

The Avoca basin was the driest in 2017–18, receiving 4% of **new** long-term average inflows: much lower than the previous year, of 74%.

Although all basins received less streamflow than in 2016–17, the Loddon basin had the biggest streamflow decrease and change from the previous year, receiving 33% of the **new** long-term average streamflows in 2017–18, compared to 258% in the previous year.

In the north:

- the Campaspe, Loddon and Broken basins received the least amount of streamflows (16%, 33% and 40% respectively of the **new** long-term average)
- the Murray, Ovens and Kiewa basins all received below-average streamflows (57%, 61% and 83% of the **new** long-term annual average).

In the north-west, much less streamflow was received than in the previous year, with the Avoca basin receiving 4% of the **new** long-term average (compared to 74% in 2016–17) and the Wimmera basin receiving 15% (compared to 162% in 2016–17).

In the south-west, the Hopkins and Portland basins received 80% and 91% respectively of the **new** long-term annual average. As explained in chapter 2.2, the **old** long-term annual average has been used to compare the Glenelg, Corangamite and Otway Coast basin inflows received in 2017–18, which were between 64% (Glenelg) and 95% (Otway Coast) of the **old** long-term annual average.

Large decreases from the previous year also occurred in the centre of the state:

- the Werribee basin received 22% of the **new** long-term annual average streamflows in 2017–18 (165% in 2016–17)
- the Maribyrnong basin received 28% of the **new** long-term annual average streamflows in 2017–18 (161% in 2016–17)
- the Moorabool basin received 53% of the **new** long-term annual average streamflows in 2017–18 (115% in 2016–17).

Table 2-1 Basin streamflows compared to long-term average

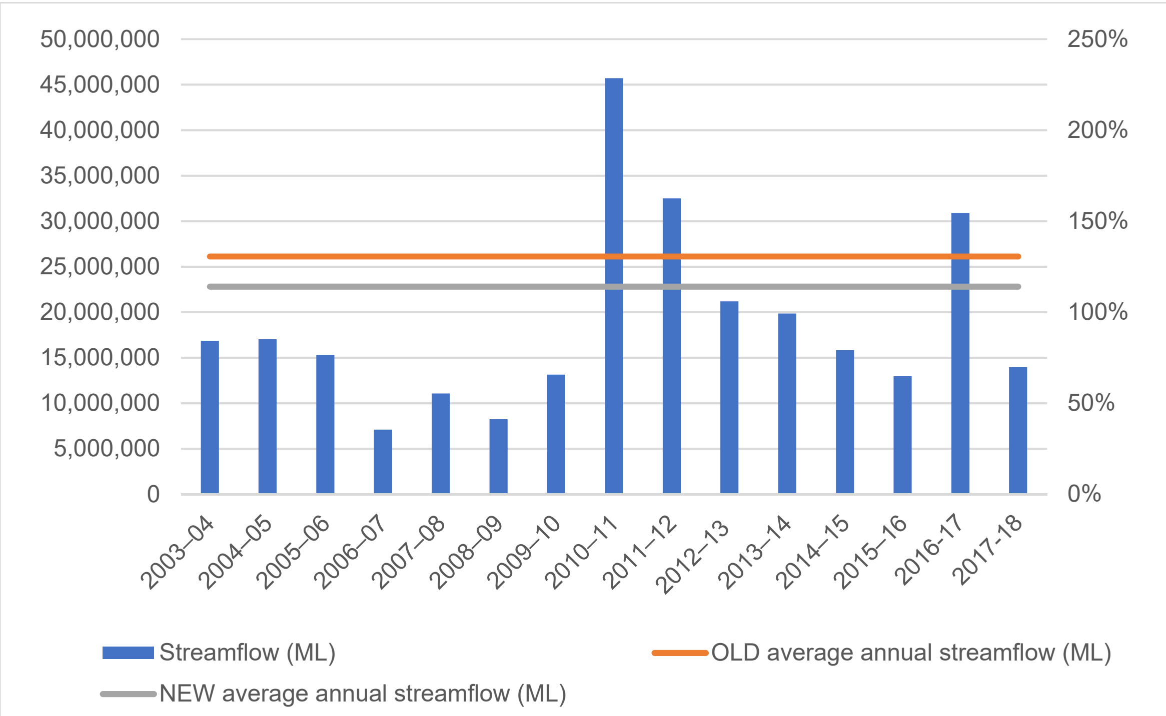
Basin	OLD Average annual streamflow (ML/year)	NEW Post-1975 annual average (ML/year) (1)	2017–18 streamflow (2)			2016–17 streamflow		
			(ML)	(% NEW LTA)	(% OLD LTA)	(ML)	(% NEW LTA)	(% OLD LTA)
Avoca	136,200	84,395	3,366	4%	2%	62,597	74%	46%
Barwon	360,000	232,508	145,604	63%	40%	335,884	144%	93%
Broken	308,000	253,089	100,536	40%	33%	543,023	215%	176%
Bunyip (3)	541,000	-	478,488	-	88%	621,609	-	115%
Campaspe	352,000	242,570	39,477	16%	11%	445,441	184%	127%
Corangamite (3)	316,000	-	282,560	-	89%	388,612	-	123%
East Gippsland	714,000	747,262	152,362	20%	21%	590,897	79%	83%
Glenelg (3)	964,000	-	617,198	-	64%	1,336,753	-	139%
Goulburn (4)	3,363,000	2,827,303	1,843,383	65%	55%	3,170,647	112%	94%

Basin	OLD Average annual streamflow (ML/year)	NEW Post-1975 annual average (ML/year) (1)	2017–18 streamflow (2)			2016–17 streamflow		
			(ML)	(% NEW LTA)	(% OLD LTA)	(ML)	(% NEW LTA)	(% OLD LTA)
Hopkins	635,000	300,588	239,832	80%	38%	550,034	183%	87%
Kiewa	689,000	672,099	555,981	83%	81%	1,092,663	163%	159%
Latrobe	847,400	829,757	492,415	59%	58%	636,929	77%	75%
Loddon	373,000	223,184	73,071	33%	20%	575,121	258%	154%
Mallee (5)	-	-	-	-	-	-	-	-
Maribyrnong	113,000	85,063	24,064	28%	21%	136,619	161%	154%
Millicent Coast (5)	-	-	-	-	-	4	-	-
Mitchell	884,500	777,733	417,895	54%	47%	1,060,803	136%	120%
Moorabool	97,000	92,180	49,122	53%	51%	105,837	115%	109%
Murray	7,618,000	6,647,925	3,807,603	57%	50%	9,837,093	148%	129%
Otway Coast (3)	884,000	-	844,092	-	95%	938,488	-	106%
Ovens	1,758,000	1,659,252	1,004,579	61%	57%	2,897,251	175%	165%
Portland Coast	361,000	379,972	344,469	91%	95%	505,275	133%	140%
Snowy (6)	1,022,000	770,741	509,900	66%	50%	1,691,959	220%	166%
South Gippsland (3)	911,500	-	694,156	-	76%	835,065	-	92%
Tambo	297,800	277,658	52,891	19%	18%	358,443	129%	120%
Thomson	1,101,760	914,072	546,937	60%	50%	962,204	105%	87%
Werribee	102,000	77,790	16,850	22%	17%	128,564	165%	126%
Wimmera	316,400	215,188	32,478	15%	10%	347,538	162%	110%
Yarra	1,054,000	884,890	599,650	68%	57%	740,939	84%	70%
Total	**26,119,560**	**22,811,719**	**13,968,960**	**61%**	**53%**	**30,896,294**	**135%**	**118%**

Notes

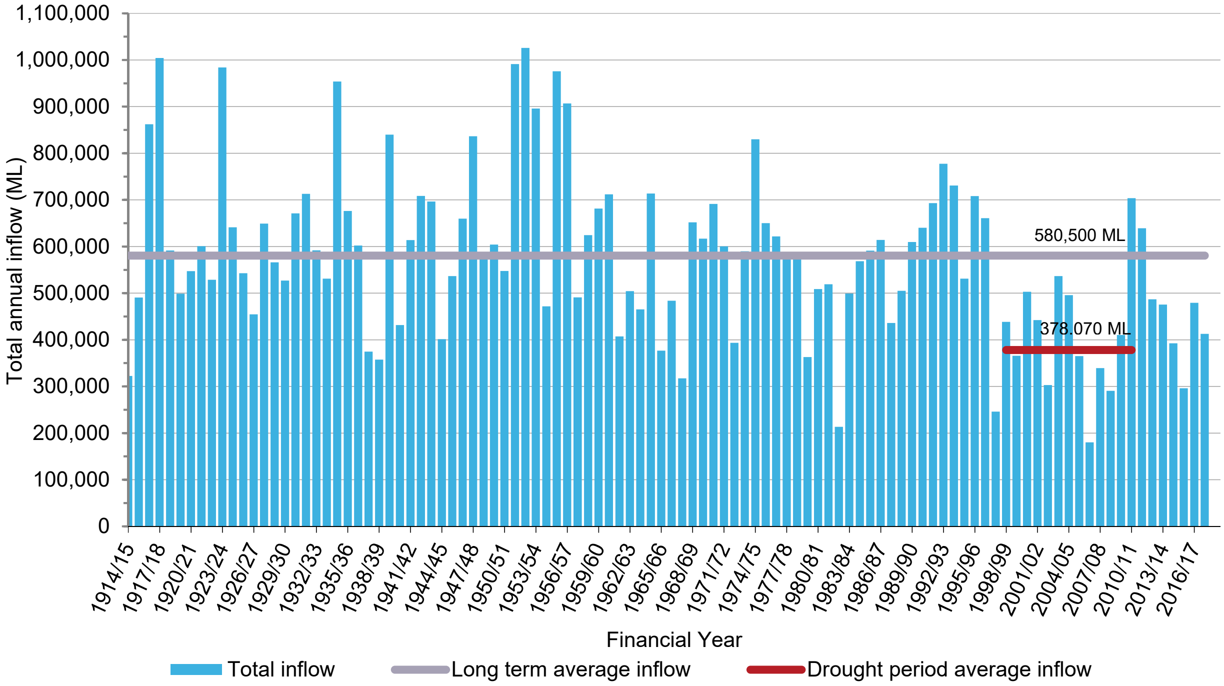
(1) The total of the new LTA inflow includes the old volume for the Bunyip, Corangamite, Glenelg, Otway Coast and South Gippsland basins, as the new LTA inflow figure has not been applied in these basins.
(2) 'Streamflow' is equivalent to 'catchment inflow' in the water balances in chapter 6.
(3) The new LTA inflow figure has not been applied in the Bunyip, Corangamite, Glenelg, Otway Coast and South Gippsland basins. The gauges used to determine the LTA are different to those used to calculate the total inflows received in 2017–18.
(4) Only includes inflows within the Goulburn basin.
(5) Surface water resources within the Mallee and Millicent Coast basins are limited and there are currently no streamflow gauges in these basins. Streamflows in the Millicent Coast basin are estimated be equal to the volume of licensed diversion from unregulated streams within the basin. There are no licensed diversions in the Mallee basin, and it is assumed it has no streamflows.
(6) Volumes shown for the Snowy basin exclude catchment inflows from New South Wales (upstream of Burnt Hut Crossing).

Figure 2-6 Total Victorian streamflow compared to the long-term average



Streamflows have a major influence on Victoria's water storages. As shown in Figure 2-6 and Figure 2-7, the total annual streamflows received in 2017–18 were much lower than those received in the previous year and almost as low as those received in 2015–16. The annual inflows to Melbourne's harvesting reservoirs in the Yarra and Thomson basins in 2017–18 were 71% (412,526 ML) of the 100-year long-term average of 580,500 ML. Although lower than the year before when 479,035 ML was received (83% of the long-term average), the volumes were more than the average inflows of the last drought (378,070 ML) (Figure 2-7).

Figure 2-7 Annual inflows to Melbourne's main harvesting reservoirs [(1)]



Note

(1) Maroondah, O'Shannassy, Upper Yarra and Thomson reservoirs.

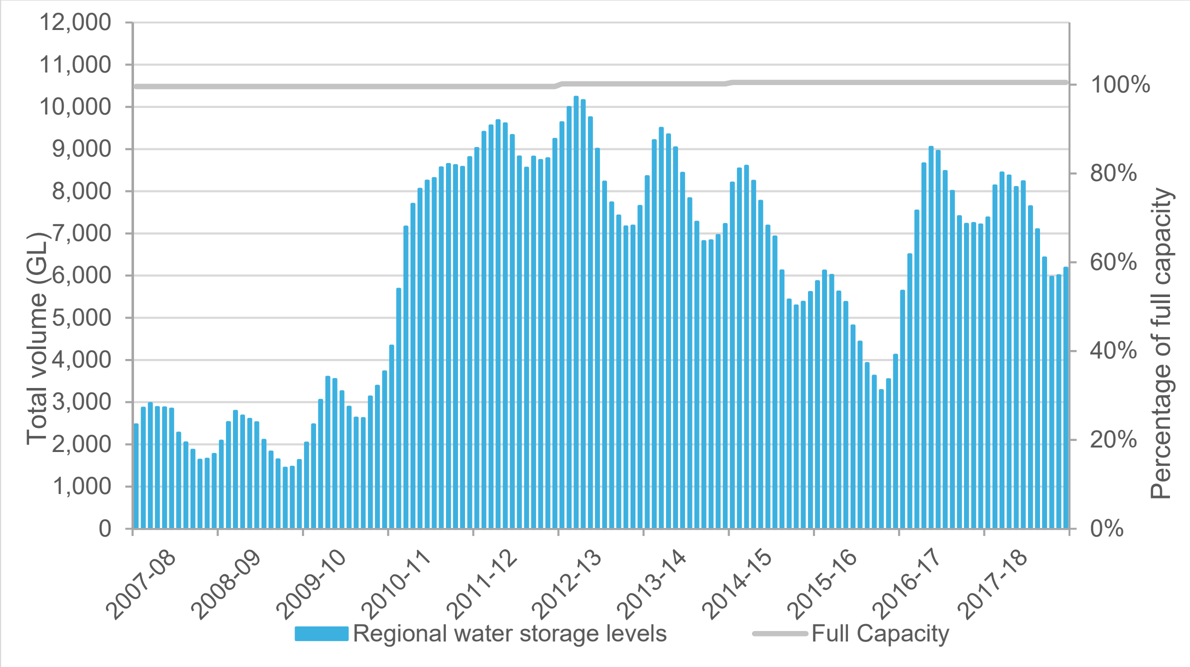
2.3 Storages

Victoria's major water storages can hold 12,521,909 ML. Of this, Melbourne's storage capacity is 1,812,175 ML and the combined capacity of the state's major regional storages is 10,709,734 ML. Information about levels held in all major storages across Victoria's river basins is in Appendix B and in the water balances in chapter 6.

A subset of about 60 of the major storages was used to provide the summary information below and in Figure 2-8 and Figure 2-9. Unlike the previous year when storages ended the year higher than they began, in 2017–18 Victoria's total storage levels started the year at 8,505,602 ML (69% of capacity) and ended at 7,242,916 ML (58% of capacity). The combined volume of water stored in Victoria's reservoirs varies both within a given year and between years.

Storage levels in Victoria's regional reservoirs started the year at 7,372,024 ML (70% of capacity) and ended at 6,185,791 ML (58% of capacity). Storage levels increased during autumn, reaching a peak of 80% of capacity in September, and they declined slowly through the summer to a minimum of 56% of capacity by April 2018 (Figure 2-8).

Figure 2-8 Volume in major regional water storages, 1 July 2007 to 30 June 2018 (1) (2) (3)



Notes

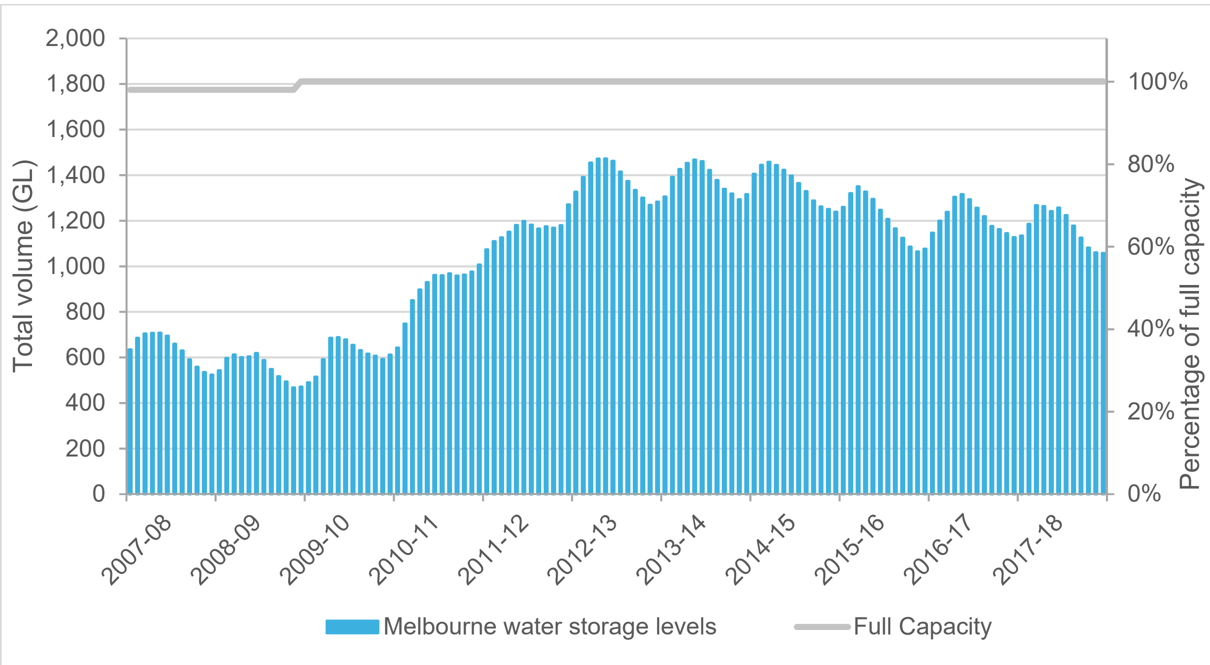
(1) The Y axis percentage relates to the current storage capacity (i.e. after the addition of the Menindee Lakes 240,000 ML in 2015–16).

(2) The mid-Murray storages have been included for the first time in the *Victorian Water Accounts 2016–17*. Reporting on storage levels began in mid-2012.

(3) The maximum operating capacity of Rocklands Reservoir was changed in 2014–15 from 261,510 ML to 296,000 ML.

In 2017–18, Melbourne's water storages started the year at 1,133,578 ML (63% of total capacity) and ended at 1,057,125 ML (58% of total capacity) after reaching a peak of 78% in October 2017 (Figure 2-9). Melbourne's water storage levels in 2017–18 were once again lower at the end of the year than they were at the start. During the latter years of the Millennium Drought (chapter 1.3.2) — between 2006–09 — storages consistently ended each year at lower levels than they had begun. Despite the significant rainfall in late 2016, inflows were below average from January to June 2017. June 2017 was most affected by the lack of rainfall, with less than half of the long-term average inflows received. The low inflows and low rainfall will have influenced the storage volumes ending the year lower than they began. Melbourne has experienced below-long-term-average inflows into storages in 18 out of the past 21 years (Figure 2-9) and Melbourne's largest reservoir, the Thomson Dam, has not been full since 1996.

Figure 2-9 Volume in Melbourne's water storages, 1 July 2007 to 30 June 2018 (1)



Note

(1) The Y axis percentage relates to the current storage capacity (i.e. after the addition of Tarago's 37,580 ML in 2010).

The Victorian Desalination Project began producing water in March 2017. The total volume delivered to 30 June 2018 was 15 GL, representing 0.83% of Melbourne' storage capacity. This is less than the 46.14 GL (or 2.55%) delivered in 2016–17. Without the water delivered in 2016–17 and 2017–18, Melbourne's storages would have finished the year at 55% in 2017–18. See chapter 1.1.4 for more information about the Victorian Desalination Project.

The total volume of water stored in Victoria's major reservoirs has historically been at its highest following winter and spring inflows, so storage levels at the end of October are traditionally used as a good indication of water availability for the remainder of that year. Figure 2-10 presents end-of-October storage levels as a percentage of storage capacity for Melbourne and selected major regional centres from October 2003 to October 2017.

During the Millennium Drought, October storage levels generally declined from 2003–07 (Figure 2-10) as inflows were not sufficient for systems to recover. A significant drop in levels occurred between 2005–06 and 2006–07, when winter and spring rainfall was extremely low across Victoria. By October 2010, storage levels had recovered significantly, with further recovery in 2011–12 across all major centres. At the end of October 2017, storages in Melbourne and the selected regional centres were between 70% and 98%. The regional storages were between 78% and 98%, which was on average lower than the previous year, when regional storages were between 81% and 100%. Melbourne storages in October 2017 were at 70%, lower than the previous year when they were at 72% (Figure 2-10).

Figure 2-10 Water in reservoirs for major urban centres at the end of October, each year from 2003 to 2017, as a percentage of total storage capacity

2.4 Groundwater

Long-term trends in groundwater levels reflect differences between the amount of water flowing into (recharge) and out of (discharge) an aquifer, and they are affected by how much is used for consumptive purposes. Groundwater level trends in shallow aquifers are more likely to reflect more-rapid changes in annual recharge from either rainfall or discharge from irrigation, whereas confined aquifer trends may show a seasonal influence from pumping within a longer-term trend.

Short-term groundwater level trends for GMUs have been determined based on five years' consistent monitoring data from key bores in the State Observation Bore Network. Trend determinations are made quarterly, when each reading is compared to previous readings in the same season (that is, a summer record is compared to previous summer records) to account for seasonality.

Groundwater level trends in 2017–18 were similar to those in 2016–17.

In the WSPAs in 2017–18, six were categorised as declining, one as rising and four stable, compared to five declining and six stable in 2016–17 (Table 2-2 and Figure 2-11). In the state's GMAs in 2017–18, 14 were declining, the same as in 2016–17; 25 were stable, compared to 23 in 2016–17; and one GMA was categorised as rising, compared to two in 2016–17 (Table 2-3 and Figure 2-12). Although water levels for most of the bores representing West Wimmera GMA had a stable trend, the Neuarpur subzone within this GMA had a declining trend throughout 2017–18.

The local management plan for the West Goulburn GMA was approved and published on 28 July 2017. The Murrayville GMA local management plan was also approved in July 2017, replacing the statutory groundwater plan which was revoked by the Minister for Water on 13 July 2017. The area of the GMA is larger, as it incorporates land and associated licensed entitlement that existed in the unincorporated area east of the boundary of the original WSPA, and the PCV (permissible consumptive volume) limit has also been increased to include this existing entitlement.

Groundwater levels in some bores remained within historical averages, while others ended the year at historical lows. Resource managers monitor and manage declining levels through a groundwater management plan and restrictions on use (see chapter 2.5.4).

Table 2-2 Groundwater level trends in water supply protection areas

Water supply protection area	Groundwater level trend 2017–18				Groundwater level trend June 2017
	Sep-17	Dec-17	Mar-18	Jun-18	
Central groundwater region					
Westernport groundwater catchment					
Koo Wee Rup	Declining	Declining	Declining	**Declining**	**Stable**
West Port Phillip Bay groundwater catchment					
Deutgam	Declining	Declining	Declining	**Declining**	**Declining**
Gippsland groundwater region					
Central Gippsland groundwater catchment					
Sale	Declining	Stable	Stable	**Stable**	**Stable**
Yarram (1)	Declining	Declining	Declining	**Declining**	**Declining**
Goulburn-Murray groundwater region					
Campaspe groundwater catchment					
Lower Campaspe Valley	Declining	Declining	Declining	**Declining**	**Declining**
Goulburn-Broken groundwater catchment					
Katunga	Declining	Declining	Declining	**Declining**	**Declining**
Loddon groundwater catchment					
Loddon Highlands	Declining	Declining	Declining	**Declining**	**Declining**
Ovens groundwater catchment					
Upper Ovens	Rising	Stable	Rising	**Stable**	**Stable**
Otway-Torquay groundwater region					
Glenelg groundwater catchment					
Glenelg	Declining	Stable	Declining	**Stable**	**Stable**
Hopkins-Corangamite groundwater catchment					
Warrion	Rising	Rising	Rising	**Rising**	**Stable**
Portland groundwater catchment					
Condah	Declining	Stable	Stable	**Stable**	**Stable**

Note

(1) Yarram WSPA water levels are influenced by offshore oil and gas extraction.

Figure 2-11 Groundwater trends in water supply protection areas

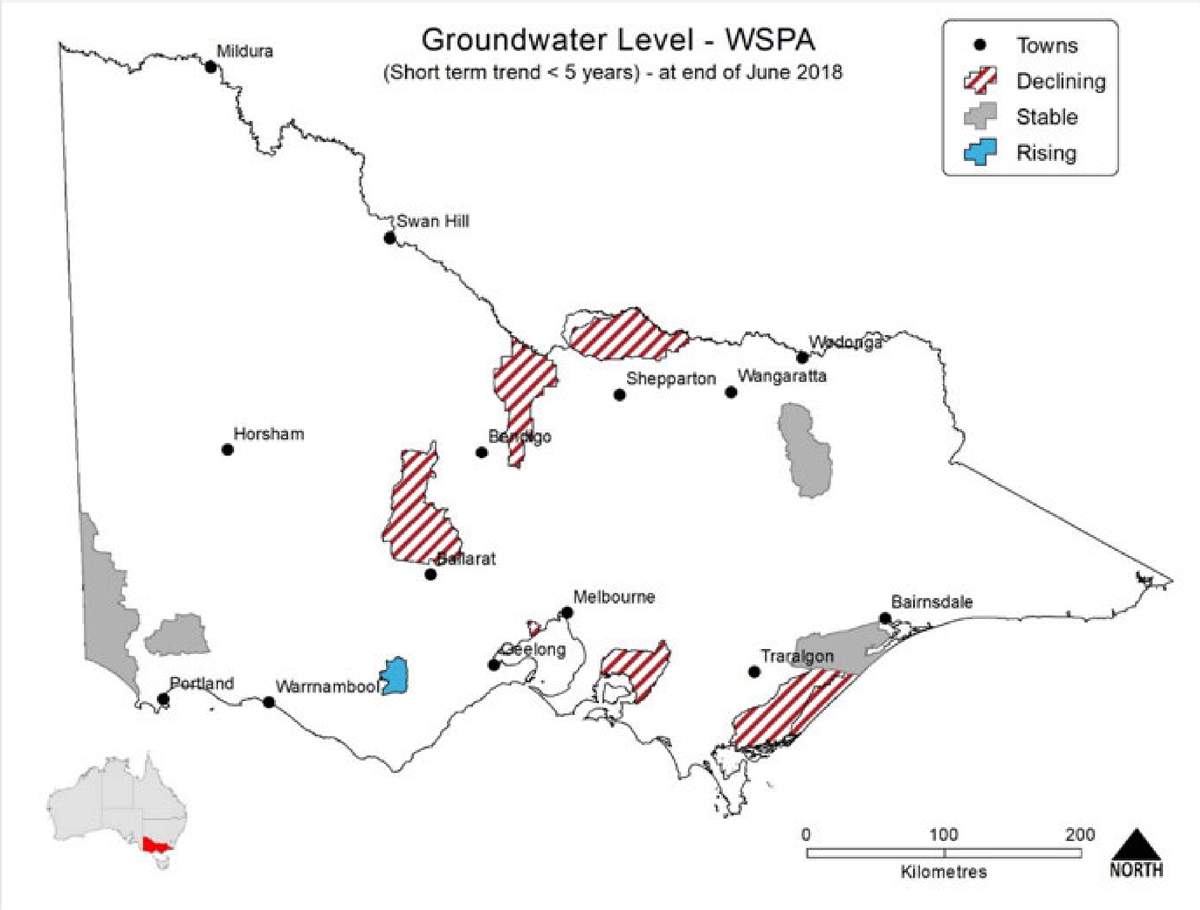


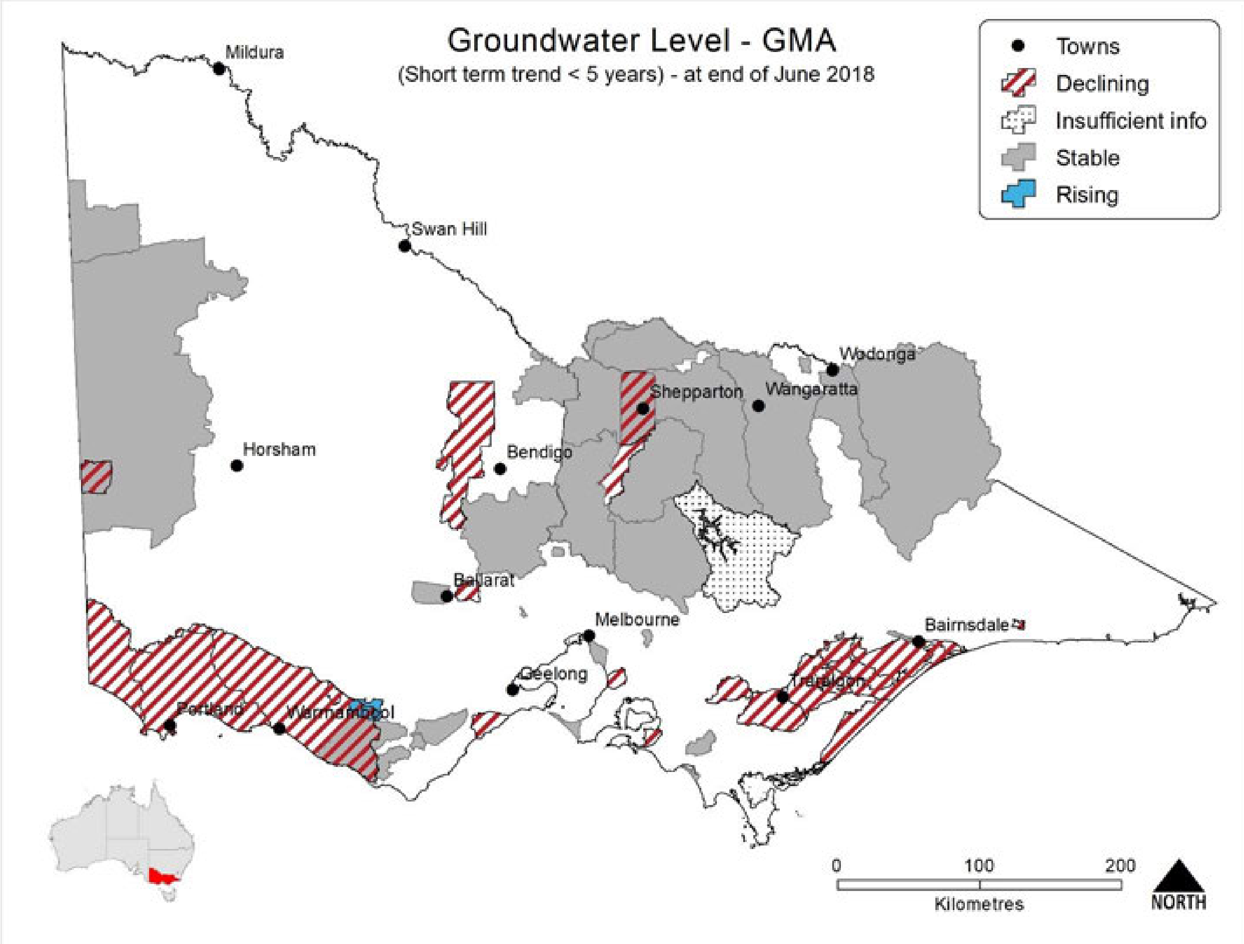
Table 2-3 Groundwater level trends in groundwater management areas

Groundwater management area [1]	Groundwater level trend 2017–18				Groundwater level trend June 2017
	Sep-17	Dec-17	Mar-18	Jun-18	
Central groundwater region					
East Port Phillip Bay groundwater catchment					
Frankston	Stable	Stable	Stable	**Declining**	**Stable**
Moorabbin	Declining	Rising	Rising	**Stable**	**Declining**
Nepean	Stable	Stable	Stable	**Stable**	**Stable**
Wandin Yallock [2]	Declining	Declining	Declining	**Stable**	**Declining**
Tarwin groundwater catchment					
Leongatha	Declining	Stable	Stable	**Stable**	**Declining**
Tarwin	Stable	Stable	Stable	**Stable**	**Stable**
Westernport groundwater catchment					
Corinella	Declining	Declining	Declining	**Declining**	**Stable**
West Port Phillip Bay groundwater catchment					
Lancefield	Rising	Rising	Rising	**Stable**	**Stable**
Merrimu	Declining	Declining	Declining	**Stable**	**Declining**
Gippsland groundwater region					
Central Gippsland groundwater catchment					
Rosedale [3]	Declining	Declining	Declining	**Declining**	**Declining**
Stratford [3]	Declining	Declining	Declining	**Declining**	**Declining**
Wa De Lock	Declining	Declining	Rising	**Declining**	**Stable**
Wy Yung	Declining	Declining	Stable	**Stable**	**Stable**
East Gippsland groundwater catchment					
Orbost	Declining	Declining	Declining	**Declining**	**Declining**
Moe groundwater catchment					
Moe	Declining	Declining	Declining	**Declining**	**Declining**

Groundwater management area (1)	Groundwater level trend 2017–18				Groundwater level trend June 2017
	Sep-17	Dec-17	Mar-18	Jun-18	
Seaspray groundwater catchment					
Giffard	Declining	Declining	Declining	**Declining**	**Stable**
Goulburn-Murray groundwater region					
Campaspe groundwater catchment					
Central Victorian Mineral Springs (4)	Declining	Stable	Stable	**Stable**	**Stable**
Goulburn-Broken groundwater catchment					
Broken	Stable	Stable	Stable	**Stable**	**Stable**
Mid-Goulburn	Declining	Declining	Declining	**Declining**	**Declining**
Shepparton Irrigation	Stable	Stable	Stable	**Stable**	**Rising**
Strathbogie	Stable	Stable	Stable	**Stable**	**Stable**
Upper Goulburn	Declining	Declining	Rising	**Stable**	**Stable**
West Goulburn (5)	Stable	Stable	Stable	**Stable**	**-**
Loddon groundwater catchment					
Mid-Loddon	Declining	Declining	Declining	**Declining**	**Declining**
Ovens groundwater catchment					
Barnawartha	Stable	Stable	Stable	**Stable**	**Stable**
Lower Ovens	Stable	Stable	Stable	**Stable**	**Declining**
Upper Murray groundwater catchment					
Kiewa	Stable	Stable	Stable	**Stable**	**Stable**
Upper Murray	Stable	Stable	Stable	**Stable**	**Stable**
Otway-Torquay groundwater region					
Hopkins-Corangamite groundwater catchment					
Bungaree (2)	Declining	Stable	Declining	**Declining**	**Stable**
Cardigan	Stable	Stable	Declining	**Stable**	**Declining**
Colongulac	Stable	Rising	Rising	**Rising**	**Rising**
Gellibrand	Stable	Stable	Stable	**Stable**	**Stable**
Gerangamete	Stable	Rising	Stable	**Stable**	**Declining**
Newlingrook	Stable	Stable	Stable	**Stable**	**Stable**
Paaratte	Stable	Stable	Stable	**Stable**	**Stable**
Southwest Limestone (6)	Stable	Stable	Stable	**Declining**	**Stable**
Otway-Torquay groundwater catchment					
Jan Juc	Stable	Stable	Rising	**Declining**	**Stable**
Portland groundwater catchment					
Portland	Declining	Declining	Declining	**Declining**	**Declining**
Wimmera Mallee groundwater region					
West Wimmera groundwater catchment					
West Wimmera	Stable	Stable	Stable	**Stable**	**Stable**
West Wimmera – Neuarpur subzone1 (7)	Declining	Declining	Declining	**Declining**	**Declining**
Wimmera Mallee groundwater catchment					
Murrayville (8)	Stable	Stable	Stable	**Stable**	**Stable**

Notes
(1) The following GMAs have been omitted from this table due to insufficient state observation bores to adequately define the groundwater resource or changes to the resource over time: Cut Paw Paw, Denison, Eildon and Glenormiston.
(2) The WSPA status of Bungaree and Wandin Yallock were revoked in December 2016.
(3) Rosedale and Stratford include the dewatering activities from the Loy Yang and Morwell coal mines.
(4) The Central Victorian Mineral Springs GMA is partly contained within the Campaspe and Loddon groundwater catchments.
(5) The local management plan for West Goulburn GMA was approved and published in July 2017.
(6) The South West Limestone GMA is partly contained within the Hopkins–Corangamite, Portland and Glenelg groundwater catchments.
(7) Restrictions on seasonal allocations are in place to address the trend deviation in the Neuarpur subzone in the West Wimmera GMA.
(8) The local management plan for Murrayville GMA was approved and published in July 2017.

Figure 2-12 Groundwater trends in groundwater management areas

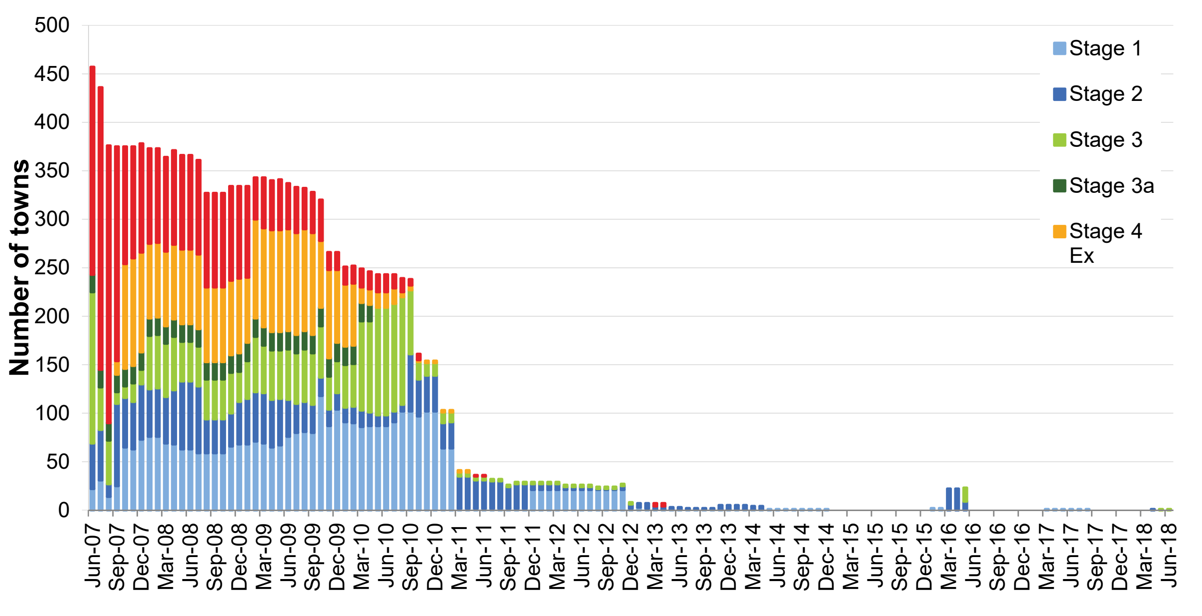


2.5 Response to water availability

2.5.1 Urban water restrictions

Urban water restrictions were only applied to one town in 2017–18, the same as in 2016–17. South Gippsland Water applied stage 1 restrictions to Korumburra in July 2017, which were lifted in August 2017. South Gippsland Water applied stage 2 restrictions to Korumburra again in April 2018, which were later increased to stage 3 in May 2018. These restrictions remained in place in Korumburra until 30 June 2018. More than 450 towns were subject to restrictions at the peak of the Millennium Drought in 2007 (Figure 2-13). All other towns remained on permanent water-saving rules in 2017–18 (Table 2-4).

Figure 2-13 Number of towns and severity of water restrictions, Victoria, June 2007 to June 2018



Note
The restriction policy outlined in 1.3.2.1 was implemented in 2011 to standardise the application of water restrictions throughout the state. Before this, water corporations could use other restriction levels stage 3a and stage 4ex.

Table 2-4 Urban water restrictions in 2017–18

Water corporation	Water system and towns	Level of water restrictions in 2017–18
Central region		
Barwon Water	All towns	PWSR applied all year
Central Highlands Water	All towns	PWSR applied all year
Melbourne metropolitan retailers (Yarra Valley Water, South East Water, City West Water)	Metropolitan Melbourne	PWSR applied all year
Southern Rural Water (Werribee and Bacchus Marsh systems)	All towns	PWSR applied all year
Westernport Water	All towns	PWSR applied all year
Western Water	All towns	PWSR applied all year
Northern region		
Coliban Water	All towns	PWSR applied all year
Goulburn-Murray Water	All towns	PWSR applied all year
Goulburn Valley Water	All towns	PWSR applied all year
Lower Murray Water	All towns	PWSR applied all year
North East Water	All towns	PWSR applied all year
Western region		
Grampians Wimmera Mallee Water	All towns	PWSR applied all year
Wannon Water	All towns	PWSR applied all year
Gippsland region		
East Gippsland	All towns	PWSR applied all year
South Gippsland Water	Korumburra	Stage 1, 2 and 3 restrictions
	All other towns	PWSR applied all year
Gippsland Water	All towns	PWSR applied all year
Southern Rural Water (Macalister system)	All towns	PWSR applied all year

Note
PWSR = permanent water-saving rules.

2.5.2 Seasonal allocation determinations in regulated systems

The above-average rainfall in the first six months of 2016–17 helped to build reserves for some of Victoria's systems for 2017–18. Aside from a few systems in northern Victoria that had built up reserves, opening allocations announced in July 2017 were low for almost all systems. By February 2018, all systems in Victoria received seasonal determinations of 100% high-reliability water shares (Table 2-5) except for the Werribee and Bacchus Marsh district.

In Victoria's declared systems, both in the north and south, all high-reliability entitlements reached 100% allocation in 2017–18, except for the Werribee and Bacchus Marsh district.

In northern Victoria, the Bullarook and Broken systems reached 100% allocation for low-reliability entitlement. The Campaspe system received a 55% allocation against low-reliability entitlements.

In southern Victoria, the Thomson–Macalister irrigation system received a 20% allocation against low-reliability entitlement.

Allocations for the Wimmera Mallee Pipeline product began with initial allocations of 37%, which then reached and remained at 81% after February 2018. In the Coliban Rural system, entitlement holders had access to 100% of their entitlement for the entire year.

Table 2-5 Seasonal water allocations in regulated water systems

Water system	Water shares	2017–18			2016–17
		Opening allocation (1) (% of entitlement)	Mid-season allocation (2) (% of entitlement)	Final allocation (3) (% of entitlement)	Final allocation (% of entitlement)
Northern declared systems					
Murray	High reliability	66	100	**100**	**100**
	Low reliability	0	0	**0**	**5**
Goulburn	High reliability	36	100	**100**	**100**
	Low reliability	0	0	**0**	**0**
Broken	High reliability	1	100	**100**	**100**
	Low reliability	0	100	**100**	**100**
Campaspe	High reliability	100	100	**100**	**100**
	Low reliability	0	55	**59**	**100**
Loddon	High reliability	36	100	**100**	**100**
	Low reliability	0	0	**0**	**0**
Bullarook	High reliability	0	100	**100**	**100**
	Low reliability	0	100	**100**	**100**
Southern declared systems					
Thomson–Macalister	High reliability	45	100	**100**	**100**
	Low reliability	0	0	**20**	**20**
Werribee and Bacchus Marsh	High reliability	5	45	**45**	**100**
	Low reliability	0	0	**0**	**75**
Non-declared systems					
Wimmera Mallee	Pipeline product	37	81	**81**	**100**
Coliban Rural	Rural licences	100	100	**100**	**100**

Notes

(1) Opening allocations are taken as the initial determination made by each resource manager at the start of July.

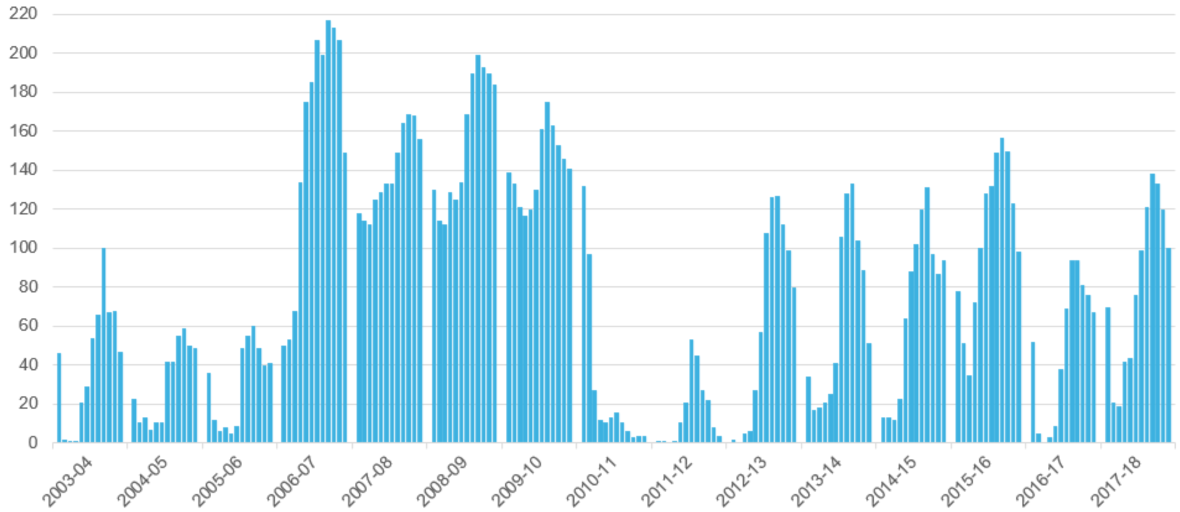
(2) Allocations in February are provided as an indication of mid-season allocations.

(3) Goulburn-Murray Water (Northern Victoria Resource Manager) announces final allocations in April while Southern Rural Water and the Wimmera Mallee Storage Manager announce final allocations in June.

2.5.3 Restrictions on diversions from unregulated streams

The number of streams on restrictions and bans reached a peak of 130 in March 2018, compared to 94 in the previous year (Figure 2-14). There were 117 streams subject to restrictions in May 2018, compared to 76 at the same time in the previous year. There were 100 streams on restrictions at the end of 2017–18, compared to 54 at the end of 2016–17.

Figure 2-14 Number of Victorian unregulated streams on restrictions, June 2003 – June 2018



2.5.4 Groundwater restrictions

Groundwater restrictions in 2017–18 were similar to the previous year, when entitlement holders in the same four GMUs were subject to restrictions on groundwater use.

In the West Wimmera groundwater catchment, an 80% seasonal allocation remained in place in the Neuarpur subzone 1 (a trading zone in the West Wimmera GMA).

In the Goulburn-Broken groundwater catchment, Katunga WSPA had a seasonal allocation of 70% in all zones. This increased to 100% in September 2017, the first time since the plan was implemented.

In the Loddon groundwater catchment, all management zones in the Loddon Highlands WSPA had an allocation of 100% except for the Newlyn Zone, which had an allocation of 75% in 2017–18.

In the West Port Phillip Bay groundwater catchment, the Deutgam WSPA opening allocation for the 2017–18 irrigation season from 1 July 2017 was 50%. This allocation was increased on 19 December 2017 to 100% for the remainder of the season.

2.5.5 Water-carting

Water-carting is an option that water corporations use to augment town supplies when local sources cannot meet demand. Doing so can be a time-consuming and expensive exercise and is usually only a last resort to supply smaller towns. In recent years, water-carting has been required to address water scarcity, particularly during drought periods. In 2017–18, water-carting was not used to supplement supplies.

2.5.6 Temporary qualification of rights to water

In 2017–18, the Minister for Water did not qualify any rights to water in regulated systems.

3. Water for consumptive use

Water for consumptive use in Victoria is taken from reservoirs, streams and aquifers under entitlements issued and authorised under the *Water Act 1989*, as explained in chapter 1.

Generally, water for consumptive use is allocated to either water corporations (which are granted bulk entitlements) or to individuals (who are issued a water share or a take and use licence).

In addition to formally issued entitlements, the Act enables individuals to take water for domestic and stock use from a range of surface water and groundwater sources without a licence (for example, from a small catchment dam). These domestic and stock rights are defined in section 8 of the Act and are not formally licensed.

Small catchment dams can be either registered and licensed or unlicensed, depending on the amount of use and capacity. Where the capacity is small and use is restricted to domestic household and stock watering, then this is unlicensed consistent with section 8 of the Act. Where the capacity is larger and/or use is for commercial purposes including irrigation then the dam must be registered and licensed.

As well as consumptive uses, the Act provides for water to be used for environmental purposes (chapter 4). Environmental use is not reported in this chapter.

Table 3-1 shows the volume of water defined in entitlements for consumptive use in Victoria in 2017–18 and 2016–17. This report does not include an estimate of the volume of domestic and stock use pumped from a waterway. The total volume of consumptive entitlements changes each year as new entitlements are issued or existing entitlements are modified. All basins in the state have a cap, which limits the volume of water that can be allocated. Most basins have reached the cap and allocated all available water within the limit, and thus only a minor change in the total number of entitlements will occur from one year to the next. In catchments which have reached the cap, no new entitlements are created unless water savings are made. In a system which has reached its cap, the only way for a customer to get more entitlement is to purchase it from someone selling unwanted or unused entitlement. The cap and trade system ensures no net increase in entitlements in a catchment which has reached the cap.

Table 3-1 Consumptive water entitlements in Victoria, 2017–18 and 2016–17

Entitlement type	Volume 2017–18 (ML)	Volume 2016–17 (ML)
Surface water		
Bulk entitlements [(1)]	5,582,495	5,556,491
Licences [(2)]	274,428	274,287
Small catchment dams [(3)]	137,502	434,974
Total surface water entitlements	**5,994,424**	**6,265,752**
Groundwater		
Licences	957,100	961,575
Bulk entitlements	10,000	10,000
Total groundwater entitlements	**967,100**	**971,575**
Total entitlements	**6,961,524**	**7,237,327**

Notes

(1) Bulk entitlement volumes are represented as the volume that can be taken in a one-year period. They are not adjusted to reflect carryover available, trade, caps that are climatically adjusted or caps that are long-term rolling averages. Bulk entitlements and environmental entitlements held by the VEWH are not included as water taken under these entitlements is not considered to be for consumptive purposes.

(2) Includes licences issued for unregulated rivers only. The volume of licences within regulated water supply systems is not included as these licences are included under rural water businesses' bulk entitlements.

(3) This includes small catchment dams required to be licensed or registered under the *Water Act 1989* as well as the volume estimated for domestic and stock use, but it excludes domestic and stock use pumped from a waterway. The total entitlement volume is assumed to be equal to the estimate of total water taken by small catchment dams for the year.

The availability and use of Victoria's water resources for 2017–18 is summarised in Table 3-2.

The volume of water taken or the water-use data presented in this overview and in the surface water river basin accounts is reported as the volume of water diverted from a water source. It is the bulk volume of water extracted from a stream or groundwater bore. It is not the end use on a farm or in a town.

Overall, the total available volume of Victoria's surface water, groundwater and recycled water in 2017–18 was 15,375,034 ML, less than half the amount available in the previous year. Of this, 4,087,408 ML was taken for consumptive uses, higher than the 3,633,465 ML taken in 2016–17.

The volume of surface water taken in 2017–18 was 59% of the total entitlement volume.

Table 3-2 Victoria's water availability and water taken for consumptive use, 2017–18

Water source	Available resource (ML)	Total entitlements (ML)	Total taken (ML)
Surface water (1)	13,968,960	5,994,424	3,550,404
Groundwater (2)	931,193	967,100	439,845
Recycled water (3)	474,881	n/a	97,159
Total 2017–18	**15,375,034**	**6,961,524**	**4,087,408**
Total 2016–17	32,239,118	7,060,145	3,633,465

Notes

(1) The volume of available surface water resources is assumed to be the volume of catchment inflow for all Victorian basins, as determined in the surface water balance for each basin presented in chapter 6.

(2) The actual groundwater resource (that is, the volume of water in aquifers) is unknown. The total resource has been assumed to be the sum of the PCV of each GMU plus entitlement volume where the GMU does not have a PCV.

(3) The volume of available recycled water is assumed to be the volume of wastewater produced at treatment plants.

n/a Not applicable.

3.1 Surface water entitlements and use

The following provides an overview of surface water taken under consumptive entitlements across Victoria.

Table 3-3 summarises the volume of water taken under bulk entitlements, licences and small catchment dams in each basin in 2017–18. Part 2 has more information about diversions under surface water entitlements in each basin. The entitlements and their volumes are detailed in chapter 6 for each basin. Environmental entitlements are explained separately in chapter 4, as they are not considered to be consumptive uses entitlements.

The amount of water taken for consumptive uses increased in 2017–18 from the previous year. The majority of the increase in bulk entitlement volumes taken from 2016–17 to 2017–18 is attributed to increased use in the Murray and Goulburn basins. The volume of water taken under bulk entitlements in 2017–18 was 60% of the total volume of bulk entitlements, higher than the previous year when 50% was taken. The volume of water taken under take and use licences was 27% of the total volume of licences, which was similar to the previous year (26%).

Table 3-3 Volume of surface water entitlements and volume and percentage taken for consumptive use, 2017–18

Basin	Bulk entitlements (1)			Licences (2)			Small catchment dams (3)
	Entitlement volume (ML) (4)	Volume taken (ML)	Proportion of entitlement taken (%)	Entitlement volume (ML)	Volume taken (ML)	Proportion of entitlement taken (%)	Volume taken (ML)
Murray	1,867,091	1,331,122	71%	16,228	3,467	21%	6,264
Kiewa (5)	2,206	1,009	46%	15,507	4,635	30%	3,225
Ovens (5)	49,322	13,589	28%	17,223	3,858	22%	7,666
Broken	25,279	11,112	44%	2,716	653	24%	3,379
Goulburn	2,087,447	1,055,958	50%	24,089	6,798	28%	17,258
Campaspe	105,648	53,393	51%	2,921	661	23%	7,210
Loddon	125,590	29,226	23%	22,129	5,403	24%	7,475
East Gippsland	622	118	19%	657	49	7%	362
Snowy	2,201	723	33%	3,949	869	22%	1,092
Tambo	342	28	8%	4,151	633	15%	912
Mitchell	9,208	4,953	54%	16,385	13,623	83%	605
Thomson	404,559	370,787	92%	17,237	4,803	28%	478
Latrobe	221,692	77,765	35%	18,891	6,279	33%	7,388
South Gippsland	18,887	7,871	42%	12,743	3,308	26%	14,419
Bunyip	36,595	24,304	66%	18,862	5,416	29%	12,590
Yarra	400,000	255,317	64%	42,719	6,295	15%	7,872
Maribyrnong	10,711	3,464	32%	2,054	366	18%	2,247
Werribee	37,617	14,885	40%	901	27	3%	1,144
Moorabool	40,600	13,609	34%	3,573	1,344	38%	3,127
Barwon	54,733	38,559	70%	5,508	1,028	19%	4,785
Corangamite	0	0	0%	1,117	47	4%	2,009
Otway Coast	19,667	13,262	67%	6,436	715	11%	9,535
Hopkins	629	175	28%	11,395	2,439	21%	3,738
Portland Coast	0	0	0%	1,078	0	0%	1,931
Glenelg	4,554	1,876	41%	1,044	92	9%	7,107
Millicent Coast	0	0	0%	4	4	100%	689
Wimmera	57,016	16,473	29%	2,223	422	19%	2,136

Basin	Bulk entitlements [1]			Licences [2]			Small catchment dams [3]
	Entitlement volume (ML) [4]	Volume taken (ML)	Proportion of entitlement taken (%)	Entitlement volume (ML)	Volume taken (ML)	Proportion of entitlement taken (%)	Volume taken (ML)
Mallee	0	0	0%	0	0	0%	0
Avoca	278	47	17%	2,689	42	2%	861
Total 2017–18	**5,582,495**	**3,339,628**	**60%**	**274,428**	**73,275**	**27%**	**137,502**
Total 2016–17 [6]	5,556,491	2,691,569	48%	274,287	71,438	26%	434,974

Notes

(1) Bulk entitlement volumes are represented as the volume that can be taken in a one-year period. They are not adjusted to reflect carryover available, trade, caps that are climatically adjusted or caps that are long-term rolling averages. Bulk entitlements and environmental entitlements held by the VEWH are not included as water taken under these entitlements as they are not considered to be for consumptive purposes.
(2) Includes only take and use licences issued for unregulated rivers. Licences within regulated water supply systems are not included as they are part of rural water corporations' bulk entitlements.
(3) Not all small catchment dams are required to be licensed or registered under the Act (for example, farm dams for domestic and stock use); the estimated volume of water used is presented.
(4) The bulk entitlement volumes for the Loddon and Thomson basins were incorrectly published in 2016–17, and they should have been 125,590 ML and 395,896 ML respectively.
(5) The urban licence for Beechworth has been moved from the Ovens basin into the Kiewa basin.
(6) 2017–18 is the first year that some additional components of bulk entitlements have been reported in the accounts. This detail has been included to provide more clarity about the entitlement and does not represent a change in the entitlement. These changes do not represent an increase to the volume of water entitlement: rather, they provide a more-complete view of all the possible volumes available under the entitlements. The total volume reported for 30 June 2017 differs from the volume reported in the 2016–17 accounts, to reflect the volume that would have been reported if all the components of the entitlements reported this year were included.

During 2017–18, there were three amendments to entitlements and a new entitlement was issued.

- A new environmental entitlement for the Upper Barwon River was established on 4 April 2018. The *Upper Barwon River Environmental Entitlement 2018* provides 1,000 ML a year on average for the West Barwon River, East Barwon River and their tributaries, by allocating a 3.8% share of inflows into the West Barwon Reservoir and a 2,000 ML share of the reservoir storage capacity to the VEWH. An amendment to Barwon Water's upper Barwon system bulk entitlement was also required, to give effect to the new environmental entitlement and to clarify arrangements associated with the management of the environmental entitlement. This follows major infrastructure augmentations to the water supplies for Geelong, which have reduced the reliance of those communities on harvesting from the upper Barwon River.
- On 28 February 2018, the loss allowance in Goulburn-Murray Water's Eildon – Goulburn Weir bulk entitlement was reduced, to enable the issue of water shares to the Commonwealth Environmental Water Holder (CEWH) arising from water savings from the Goulburn-Murray Water Connections Project. This was required to meet one of the Victorian Government's commitments under stage 2 of the Connections Project.
- Southern Rural Water's Thomson/Macalister bulk entitlement was amended on 7 June 2018, to clarify the approach to be taken by Southern Rural Water and the VEWH when passing flows are varied.

All changes to bulk entitlements are administered under part 4, division 1 of the Act and require consultation and consideration of matters including the impact on current users and the environment.

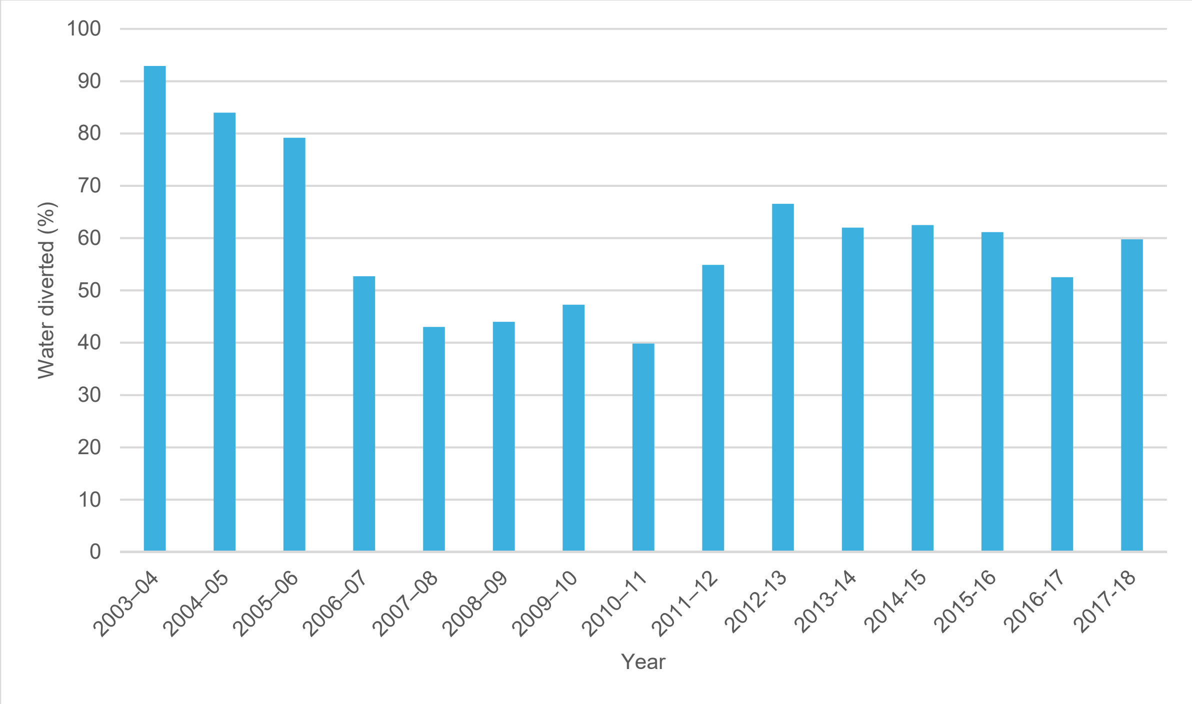
Figure 3-1 shows the volume of water taken under surface water entitlements in the past 14 years.

In any given year, there is typically a gap between the total volume of entitlements — water that can be legally used — and the actual volume of water taken. This is due to a range of reasons including:

- dry climatic conditions (so there is not enough water available to take the total volume of entitlements)
- wet climatic conditions (so there is reduced need to take the total volume of entitlements)
- individual entitlement holders choosing not to take all the water they have a right to use.

The lower water use over the period 2006–07 to 2009–10 is a reflection of the extremely dry climatic conditions and limited water availability during the Millennium Drought. During this period, restrictions on water use by urban customers, low seasonal allocations in the irrigation districts and rosters and restrictions on licensed diversions from unregulated streams were widespread. In contrast, the low water use recorded in 2010–11 and 2011–12 is a reflection of suppressed demand for water due to the wet conditions experienced during these years. Although lower water use was again observed in 2017–18, it was also higher than the previous year, reflecting the drier conditions during the year.

Figure 3-1 Percentage of entitlement volume diverted for consumptive use



Surface water entitlements are used for many different purposes, but they can broadly be classified according to the following end uses of water:

- irrigation (agriculture)
- domestic and stock (rural household use and stock watering)
- urban (town water supply for households and businesses) and commercial (major non-agricultural water use)
- power generation (a separate category, due to the water-intensive nature of its operations).

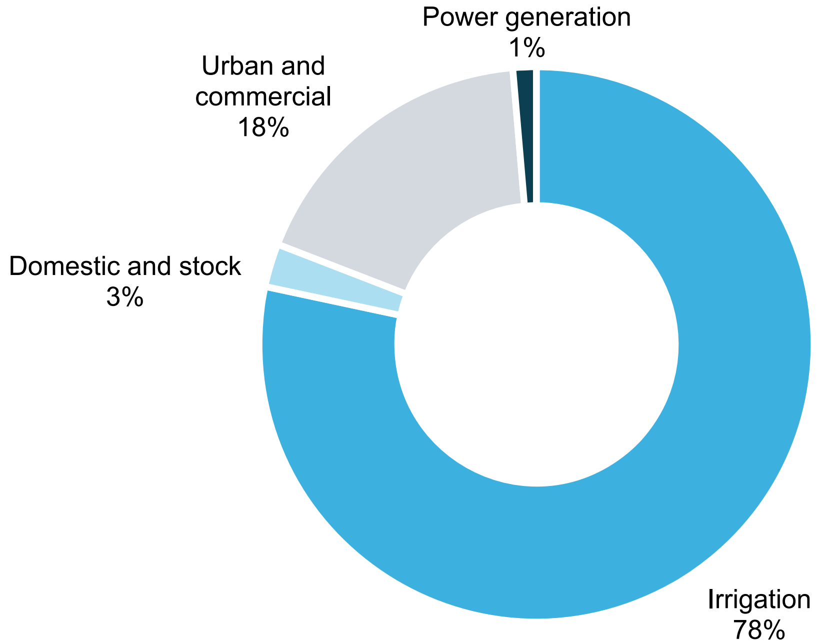
As shown in Table 3-4, the volume of water taken for consumptive use under surface water entitlements in 2017–18 was more than in 2016–17.

Irrigation is the largest consumptive use of surface water in the state, comprising 78% of all water taken in 2017–18, as shown in Figure 3-2.

Table 3-4 Volume of water taken for consumptive use under surface water entitlements

Consumptive end use	2017–18		2016–17	
	Volume diverted (ML)	Proportion of total consumptive diversions (%)	Volume diverted (ML)	Proportion of total consumptive diversions (%)
Irrigation	2,781,684	78%	2,267,925	71%
Domestic and stock	89,861	3%	245,238	8%
Urban and commercial	630,414	18%	663,545	21%
Power generation	48,446	1%	21,274	1%
Total	**3,550,404**	**100%**	**3,197,982**	**100%**

Figure 3-2 Percentage of water taken for different consumptive uses under surface water entitlements, Victoria, 2017–18



3.2 Groundwater entitlements and use

The following changes were made to GMUs in 2017–18.

- The West Goulburn GMA local management plan was approved in July 2017.
- In July 2017, the Murrayville WSPA became a GMA and:
  - the WSPA status was abolished and the local management plan for the Murrayville GMA was approved
  - the PCV and the boundary was amended to incorporate land and associated licensed entitlement that existed in the unincorporated area east of the boundary of the original WSPA.
- The Paaratte GMA PCV order was amended in May 2018 to distinguish it from other overlying and underlying geological formations. The volume remained the same (4,606 ML) but now allows for additional water (up to a total of 4,692 ML per year) to be taken for single-pumping tests or Managed Aquifer Recharge schemes.
- The Wandin Yallock and Stratford PCVs were increased in May 2018 (3,027 ML and 27,686 ML respectively).

Full details of water entitlements and use from each GMA and WSPA in 2017–18 are in Appendix C.

In 2017–18, total groundwater licensed entitlement was 967,100 ML across the state. The total groundwater use across the state including domestic and stock use was 439,845 ML, which was more than the volume used in 2016–17 (351,672 ML).

There are 27,465 stock and domestic bores in Victoria. Domestic and stock use (45,444 ML) was estimated to account for about 10% of total groundwater use.

In Victoria's GMAs, licensed groundwater entitlements totalled 632,329 ML with total metered use of 254,820 ML. Licensed groundwater entitlements in WSPAs totalled 242,386 ML with total metered use of 121,659 ML. The volume of groundwater entitlements outside GMUs (previously known as unincorporated areas) was 92,385 ML, with 17,922 ML of metered extraction.

The total volume of groundwater extracted for urban use in 2017–18 was 8,925 ML, which was about 2% of the total groundwater extracted.

A total of 71 cities and towns have a groundwater entitlement for primary or supplementary water supply. In 2017–18, 57 of these cities and towns recorded some level of groundwater extraction. The largest urban users were Portland and Sale, with extraction of 1,738 ML and 1,850 ML respectively.

Figure 3-3 shows cities and towns where there is an entitlement to extract groundwater and where groundwater was extracted for urban water supply in 2017–18.

Figure 3-3 Towns with groundwater extraction entitlement and extractions for urban supply in 2017–18

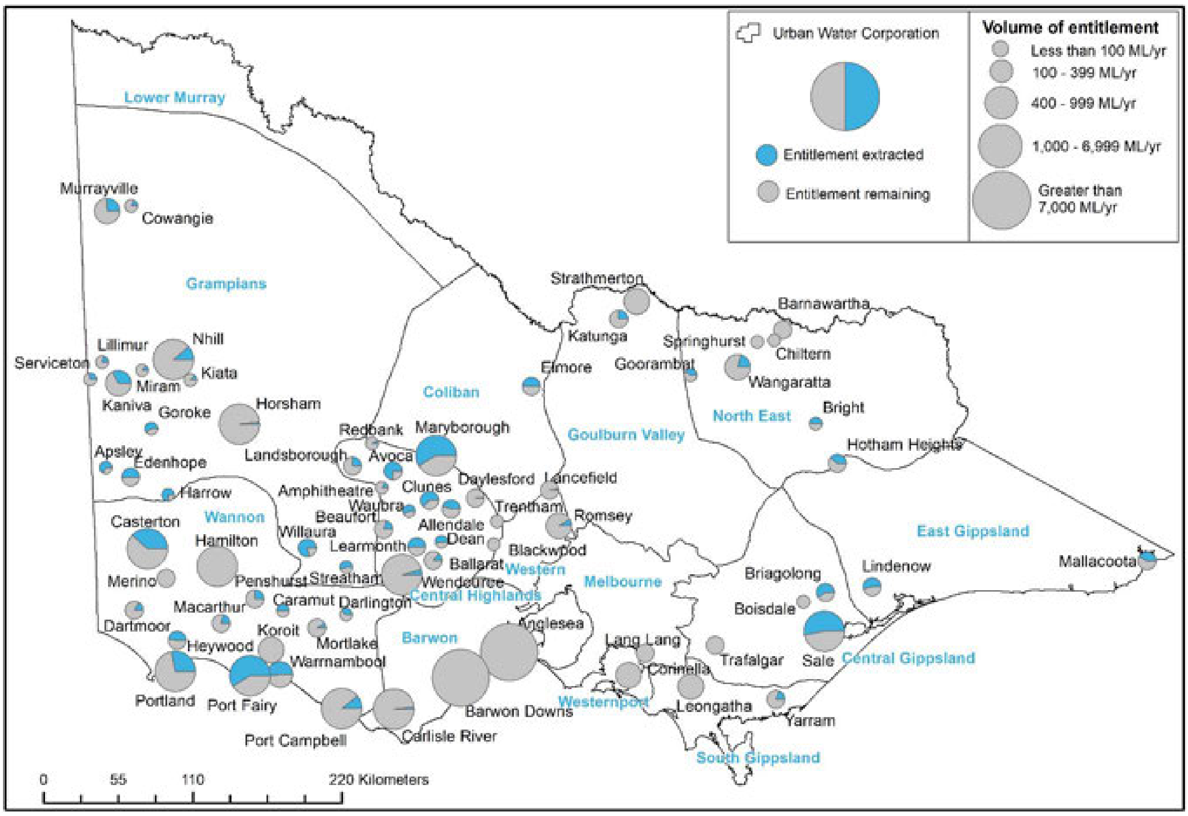
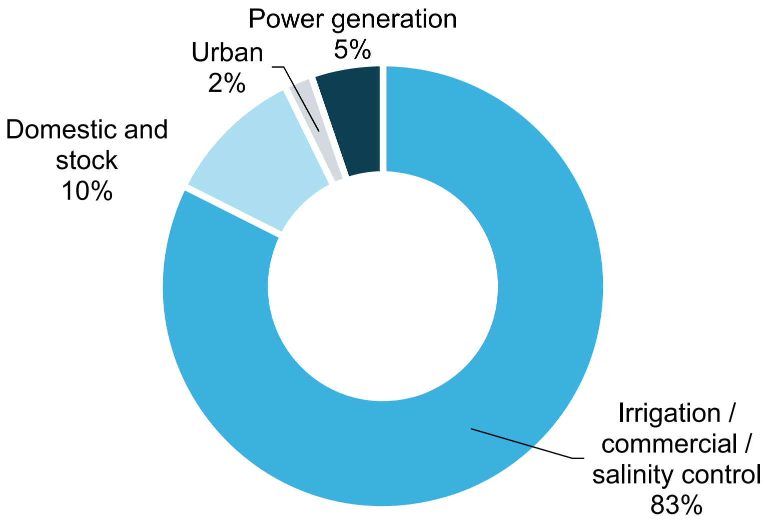


Table 3-5 and Figure 3-4 show the groundwater extraction by type of use in 2017–18.

Table 3-5 Groundwater extraction by type of end use, 2017–18

Consumptive end use	2017–18		2016–17	
	Volume diverted (ML)	Proportion of total consumptive diversions (%)	Volume diverted (ML)	Proportion of total consumptive diversions (%)
Irrigation / commercial / salinity control	362,518	83%	267,716	76%
Domestic and stock	45,444	10%	47,465	13%
Urban	8,925	2%	9,824	3%
Power generation	22,958	5%	26,667	8%
Total	**439,845**	**100%**	**351,672**	**100%**

Figure 3-4 Groundwater extraction by type of end use, 2017–18



3.3 Recycled water production

The total volume of 474,881 ML of wastewater produced in 2017–18 was less than the 493,601 ML produced in 2016–17 (Table 3-6). The volume of water recycled by Victoria's water corporations increased from the previous year, and use internal to treatment plants (within process volumes) was slightly higher than in 2016–17. In 2017–18, use external to treatment plans was 78,307 ML, which was more than the 65,294 ML recycled for external uses in 2016–17. An additional 18,850 ML was recycled for use in wastewater treatment processes. The volumes and percentages only refer to recycled water supplied for uses external to the wastewater treatment plants, and it does not include the water recycled within the plant processes.

The volume of water recycled in Melbourne, which is defined as water treated in the Bunyip, Werribee and Yarra basins less the regional towns in those basins, was 41,129 ML or 12%. The percentage of recycled water was higher outside Melbourne where weather conditions, the availability of land and access to potential purchasers (that is, agricultural producers) are more favourable. Excluding the wastewater recycled in Melbourne, the remainder of the state recycled 29% (or 37,178 ML) of the wastewater available for re-use.

A significant portion of recycled water production occurs at two treatment plants: the Eastern Treatment Plant in the Bunyip basin and the Western Treatment Plant in the Werribee basin. The quantities of recycled water vary from year to year, partly depending on customer demand. During wet years, customer demand is typically lower. In 2017–18, the volume of water recycled by the Eastern Treatment Plant was 17,724 ML, which was an increase on the 15,257 ML recycled in 2016–17.

The volume of water recycled by the Western Treatment Plant increased from 23,589 ML in 2016–17 to 29,764 ML in 2017–18.

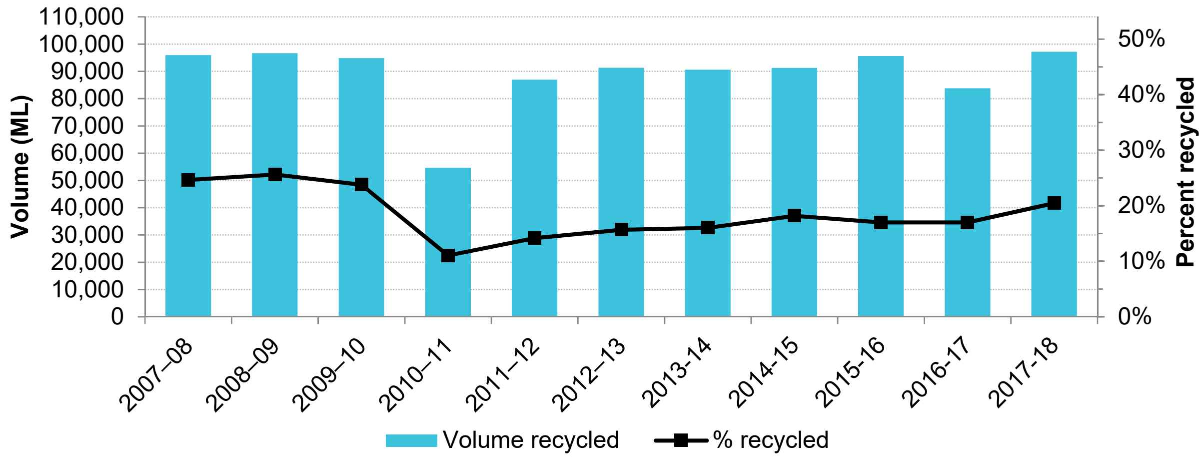
Table 3-6 Volume of wastewater recycled, 2017–18

Basin	Wastewater produced (ML)	Volume of wastewater recycled (ML)	Percentage of wastewater recycled (%)	End uses of recycled water				Volume discharged to the environment (ML)	Released to ocean/Other (ML)
				Urban and industrial	Agriculture	Beneficial allocation [1]	Within process [2]		
Avoca	258	132	51%	40	92	0	0	0	126
Barwon	34,648	3,585	10%	966	1,649	232	738	9,440	21,623
Broken	522	522	100%	0	522	0	0	0	0
Bunyip	153,613	21,945	14%	9,434	666	0	11,843	2,252	129,418
Campaspe	2,976	2,257	76%	252	2,004	0	1	720	-1
Corangamite	2,368	376	16%	12	365	0	0	1,991	0
East Gippsland	73	73	100%	0	73	0	0	0	0
Glenelg	980	681	69%	76	605	0	0	299	0
Goulburn	8,694	7,231	83%	579	6,652	0	0	1,464	0
Hopkins	6,466	1,044	16%	192	763	0	89	0	5,423
Kiewa	350	140	40%	5	135	0	0	210	0

Basin	Wastewater produced (ML)	Volume of wastewater recycled (ML)	Percentage of wastewater recycled (%)	End uses of recycled water				Volume discharged to the environment (ML)	Released to ocean/Other (ML)
				Urban and industrial	Agriculture	Beneficial allocation (1)	Within process (2)		
Latrobe	22,209	777	3%	136	54	586	0	3,691	17,741
Loddon	8,774	2,529	29%	1,297	1,232	0	0	5,645	600
Mallee	0	0	0%	0	0	0	0	0	0
Maribyrnong	5,755	4,004	70%	519	502	0	2,983	1,751	0
Millicent Coast	75	40	53%	40	0	0	0	0	35
Mitchell	1,597	1,598	100%	0	473	1,125	0	0	-1
Moorabool	1,345	1,345	100%	1,256	21	0	68	0	0
Murray	10,675	4,743	44%	155	4,483	0	105	3,711	2,222
Otway Coast	1,407	296	21%	0	296	0	0	96	1,015
Ovens	2,868	1,283	45%	82	1,201	0	0	1,585	0
Portland Coast	2,675	83	3%	0	83	0	0	316	2,276
Snowy	161	161	100%	0	161	0	0	0	0
South Gippsland	5,221	464	9%	81	373	0	11	1,199	3,558
Tambo	862	862	100%	0	862	0	0	0	0
Thomson	1,427	1,395	98%	0	1,395	0	0	31	0
Werribee	184,358	34,119	19%	10,092	17,495	6,089	443	412	149,827
Wimmera	2,436	1,455	60%	438	1,017	0	0	0	981
Yarra	12,088	4,019	33%	299	1,151	0	2,569	6,735	1,334
Total 2017–18	**474,881**	**97,159**	**20%**	**25,951**	**44,325**	**8,032**	**18,850**	**41,548**	**336,177**
Total 2016–17	493,601	83,811	17%	19,911	37,754	7,628	18,517	50,915	358,876

Figure 3-5 shows the trend in recycled water over the 10 years to 2017–18.

Figure 3-5 Recycled water volume and percentage, 2007–08 to 2017–18 (1)



Note

(1) This figure excludes recycled water used 'within process'.

3.4 Desalination water production

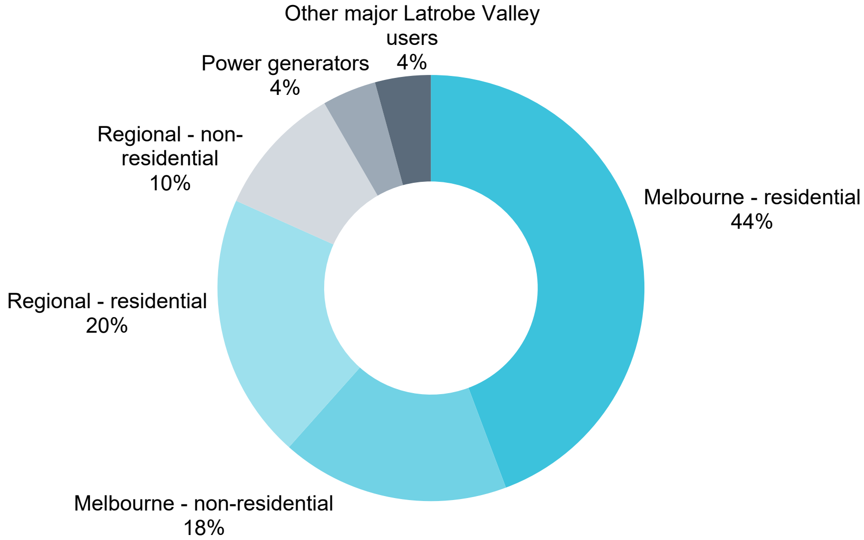
The water produced by the Victorian Desalination Project is transferred into Cardinia Reservoir and combines with the water available for consumptive uses. See chapter 1.1.4 for more information about the project.

The project began delivering water on 19 March 2017. For the 2017–18 supply period, 15,000 ML was produced.

3.5 Metered urban and commercial consumptive use

Consumption in urban areas is typically measured by the metered volume of water delivered to customers – both households (residential use) and businesses (commercial use). This figure differs from the bulk water diversion figures in Table 3-4 because water is lost in the distribution network through evaporation and leakage between the points of diversion and delivery. Therefore, the metered consumption volumes in Figure 3-6 are less than the urban diversion volumes in Table 3-4 and Figure 3-2. Chapter 8 has information about urban distribution systems.

Figure 3-6 Metered urban and commercial consumption of water, 2017–18



4. Water for the environment

Many of Victoria's rivers and wetlands have been modified as the population has grown to provide water important for towns, industry and food production. In some rivers, up to half of the water that would have naturally flowed in them is removed each year for urban consumption, irrigation and industry. As a result, these waterways are not able to function as they would naturally, and it is necessary to manage flows in them and to wetlands. Water is specifically set aside for the environment in Victoria's water management framework in three ways:

- **water entitlements**: these are rights to a share of water available each year. Most of the water entitlements held for the environment are specified as a legal right to a share of the water available in storages that can be released to meet particular environmental needs. Carryover, trade and seasonal allocation provisions are typically the same as water entitlements held for consumptive purposes. When actively managed, water available under water entitlements can be made available in the right place at the right time: when fish, birds, turtles and other animals need water to trigger feeding, breeding, fledging or migration, that water is available for them. For this reason, water entitlements held for the environment are often called **managed environmental water**
- **obligations on consumptive entitlements**: these are volumes of water that water corporations or licensed diverters are obliged to provide out of storages or past diversion points before water can be taken for consumptive use
- **above cap water**: this is water available above the total volume that can be allocated under entitlements for consumptive use.

Environmental water entitlements are held by State and Commonwealth government agencies often referred to as environmental water holders. In Victoria, this includes the VEWH, the CEWH and the Murray–Darling Basin Authority (MDBA) as part of the Living Murray program.[3]

In most cases, water held by the CEWH or the MDBA that is required for delivery in Victoria is transferred to the VEWH to enable its delivery: the water is held by the VEWH until used or transferred back.

Environmental water holders can use allocation trade to move water between different environmental water accounts for delivery. On occasion, the environmental water holders will either sell or buy water from other water entitlement holders. Such trades are recorded as commercial water trades, with a price determined via the relevant water market. Also, other water entitlement holders can choose to donate water, either as water shares or seasonal allocation, to environmental water holders.

In some systems, carryover rules allow environmental water holders to retain unused water in storage at the end of the year. This can then be used to meet environmental watering priorities in future years. The environmental water holders use carryover and trade to achieve the best environmental outcomes.

VEWH

The VEWH is an independent authority established by the Victorian Government in 2011 and responsible for managing Victoria's water for the environment. The VEWH works with local waterway managers — catchment management authorities and Melbourne Water — to ensure water for the environment achieves the best environmental outcomes. One of the VEWH's roles is to coordinate with other Murray–Darling basin environmental water holders — the CEWH, the MDBA and environmental water managers in New South Wales and South Australia — to optimise the benefits of delivery of all water for the environment in and from northern Victorian waterways.

Further information about the VEWH's planning processes for use of the environmental water holdings, the program achievements and outcomes of environmental watering in 2017–18 is available in the VEWH's annual report and annual watering booklet (*Reflections*), available at www.vewh.vic.gov.au (search 'VEWH Reflections').

CEWH

The CEWH manages the portfolio of water acquired by the Australian Government for the environment in the Murray–Darling basin. The CEWH holds Victorian water shares that were acquired through the Australian Government's investment in water-saving infrastructure and purchases. The CEWH receives annual allocations against its water shares and partners with the VEWH, the MDBA and Victorian waterway managers to deliver this water for the environment in Victoria.

More information about the CEWH is available at https://www.environment.gov.au/water/cewo.

MDBA

The MDBA manages the Living Murray Program on behalf of the basin states and the Commonwealth. This program is a partnership between the Commonwealth and the New South Wales, Victorian, South Australian and Australian Capital Territory governments. The Living Murray Program focuses on achieving agreed ecological objectives at six icon sites, chosen for their high ecological and economic value, and their cultural and heritage significance to

[3] The Victorian water entitlements for the Living Murray program are held by the VEWH in trust for the MDBA. In 2017–18, the MDBA held water shares in Victoria.

Aboriginal people. The sites encompass areas of high conservation value — the floodplains, wetlands and forests along the Murray, the Murray's estuary and the river itself. The VEWH holds some entitlements in trust for the MDBA, and decisions about the use of water under these entitlements are made by the Southern Connected Basin Environmental Watering Committee.

For more information about the Living Murray Program, visit the MDBA's site (https://www.mdba.gov.au/) or search 'Living Murray Program'.

4.1 Managed environmental water

Managing and delivering water for the environment involves careful planning by a range of people and organisations. Each year, the VEWH develops a seasonal watering plan to collaboratively manage environmental flows to improve the health of river and wetland systems including their biodiversity, ecological function and water quality.

The seasonal watering plan is a statewide plan that guides environmental watering decisions in Victoria. It provides program partners, stakeholders and communities with a sense of what to expect during the water year. The plan for the upcoming water year is released by 30 June each year.

For more information about how water for the environment is managed in Victoria, visit the VEWH's website at http://vewh.vic.gov.au/watering-program/managing-water-for-the-environment.

4.1.1 Annual overview

CEWH

In 2017–18, a total of 496,650 ML of CEWH allocation was transferred into the VEWH's accounts for use in northern Victoria. This water was used for priority watering actions in the Murray River; in the Barmah Forest; in the Goulburn, Loddon, Campaspe and Broken systems; in the Hattah Lakes; and in Gunbower Creek. Following the completion of environmental watering, 69,955 ML of unused CEWH water was traded back to the CEWH. Commonwealth environmental water was also used directly by the CEWH in the Ovens and Wimmera systems during 2017–18.

MDBA – Living Murray allocation

In 2017–18, 31,450 ML of Living Murray allocation contributed to priority watering actions in the Goulburn River and at Living Murray icon sites including the Barmah Forest and Wallpolla Island. This total included 16,500 ML of Living Murray allocation that was transferred to the South Australian Murray system from accounts held by the VEWH to meet priority watering actions in the Lower Lakes, Coorong and Murray Mouth.

VEWH

This year was the VEWH's seventh year managing water for the environment in Victoria. In 2017–18, 92% of identified potential watering actions were fully or partially achieved through a combination of managed environmental flows, natural flows, unregulated passing flows and delivery of consumptive water en route. (Table 4-1). The number of potential watering actions has increased each year since the VEWH's inception. In 2017–18, the highest number of potential watering actions was identified (283). Despite the climate being dry to very dry, the total proportion of actions achieved in 2017–18 was the second-highest since the VEWH's establishment in 2011. A slightly higher proportion of potential watering actions was achieved in 2016–17, but many of the actions in that year were supported or completely achieved by natural and unregulated flows. The high percentage of potential watering actions achieved in 2017–18 was a result of high allocations following a wet 2016–17, combined with prudent use of carryover. Many of the watering actions achieved in 2017–18 aimed to consolidate and build on environmental outcomes from the wet conditions in 2016–17.

In April 2018, the Minister for Water issued the *Upper Barwon River Environmental Entitlement 2018*. The new entitlement provides a long-term average of 1,000 ML of water a year for the Barwon River by allocating a 3.8% share of inflows into the West Barwon Reservoir and a 2,000 ML share of storage capacity in the West Barwon Reservoir to the VEWH.

In 2017–18, the volume of the VEWH's entitlements to water savings in the Goulburn and Murray systems from the Goulburn-Murray Water Connections Project stage 1 was adjusted in line with the annual audit of the long-term water savings achieved to date. The adjustment resulted in a net increase of 974.3 ML to the VEWH's holdings across the two systems. The entitlement volumes reflect the modelled long-term average savings inclusive of the past year. The volumes are used to assess interim carryover capacity while the modernisation works are still being implemented. They do not reflect the final size of the VEWH's entitlements to water savings from the Goulburn-Murray Water Connections Project stage 1, which will be confirmed and formally issued once the project is completed.

The VEWH coordinated delivery of environmental water to 88 priority river reaches and 83 wetlands, a total of 171 sites across Victoria. More wetlands and reaches were actively watered in 2017–18, due to high water availability and dry conditions, and because site managers were delivering many environmental flows to capitalise on the environmental gains achieved in the previous, wet year.

Table 4-1 Watering actions achieved

Managed environmental watering sites	2017–18	2016–17
Number of river reaches delivered to	88	76
Number of wetlands delivered to	83	51
Number of potential watering actions achieved	241	250
Percentage of potential watering actions achieved	92%	98%
Percentage of potential watering actions achieved using managed environmental water	78%	54%

The volume of total managed environmental water available in 2017–18 was 2,026,782 ML, which was more than the year before. Of this total available, 918,615 ML of environmental water was delivered during the year to priority river reaches and wetlands in Victoria. Table 4-2 summarises Victoria's managed environmental watering in 2017–18.

Table 4-2 Summary of managed environmental watering, 2017–18 (ML)

Managed environmental water	2017–18	2016–17
Availability		
Carryover	484,564	561,839
Seasonal allocations	929,072	1,160,364
Return flows (1)	665,589	229,776
Less carryover lost to spill	-52,443	234,362
Total available (2)	**2,026,782**	**1,717,617**
Environmental deliveries		
Volume delivered to off-stream wetlands	154,107	69,772
Volume delivered in-stream	764,507	636,696
Total volume delivered	**918,615**	**706,468**

Return flows

In some systems, water for the environment delivered through upstream sites can be used again downstream without impacting other entitlement holders. This helps to ensure it is used efficiently and effectively to achieve optimal environmental benefits. Access to return flows for the environment is enabled through rules in the VEWH's bulk and environmental entitlements.

In 2017–18, a total of 665,589 ML was recredited to the VEWH's accounts for return flows delivered through upstream sites to the Murray River.

Environmental water holders use trade to manage their water portfolios. Trades include administrative transfers (moving water between environmental water holder accounts) and commercial trades (selling and purchasing allocation on the market). In 2017–18, allocation trades undertaken by environmental water holders included:

- selling and buying water allocation to non-environmental users commercially
- transferring water between Victorian systems to achieve outcomes and maximise water availability
- transferring all allocations made to the Snowy Water Initiative entitlements to the Snowy Scheme in accordance with conditions of those entitlements (see chapter 4.1.3 for further details)
- transferring allocation to South Australia for delivering environmental outcomes in the downstream Murray River.

Table 4-3 presents key trade activities undertaken by environmental water holders in 2017–18.

Table 4-3 Summary of key trade activities undertaken by environmental water holders, 2017–18 (ML)

Managed environmental water – other actions	2017–18	2016–17
Net volume sold to non-environmental users (ML)	15,000	20,000
Volume transferred to the Snowy Scheme (ML) (1)	83,813	85,910
Volume delivered via the Murray River to South Australia (ML)	691,151	305,827
Total other actions (ML)	**789,964**	**411,737**

Note

(1) The volume of allocation transferred from the Victorian Murray, Goulburn and Loddon systems to the Snowy Mountains Scheme for increasing environmental flows in the Snowy and Murray rivers.

4.1.2 Water entitlements, availability and use

Managed environmental water is held in 14 Victorian river basins. Table 4-4 presents for each river basin the volume of entitlements at 30 June 2018 and the volumes made available and used during 2017–18. A total of 2,026,782 ML was made available under these entitlements during the year (before trade), of which 918,615 ML was used for environmental benefits within Victoria.

The table includes entitlements held in Victorian river basins for environmental purposes by the VEWH, the CEWH and the MDBA (for the Living Murray Program). Entitlements in each system can have different reliability (or security of supply), in Table 4-4 these are categorised as:

- high reliability: legally recognised, secure entitlements to a defined share of water; full allocations are expected in most years
- low reliability: legally recognised, secure entitlements to a defined share of water; full allocations are expected only in some years
- provisional: these entitlements provide access to water based on specific conditions in the related bulk or environmental entitlement
- unregulated: an entitlement linked to flow conditions in the river rather than volumes of water in a storage; these entitlements permit diversion of in-river flows above a certain height or rate, or flows that are in excess of what can be captured in storage
- share of inflows: specified as a share of inflows into water storages that can be released to meet particular environmental needs

Table 4-4 Environmental water availability and use, 2017–18 (ML)

Basin	Entitlement type/ reliability	Entitlement volume at 1 July 2017	Net carryover at July 2017 (a)	Carryover / allocation lost to spill (b)	Seasonal allocation / share of inflows (c)	Return flows [1] (d)	Total available (pre trade) (e) = (a)-(b)+(c)+(d)	Net trade in [2] (f)	Volume used (g)	Closing balance at 30 June 2018 (h) = (e)+(f)-(g)
Northern systems										
Murray [3]	High	446,449	298,036	-52,335	664,496	660,284	1,570,481	-718,213	374,973	477,296
	Low	137,656								
	Provisional	75,024								
	Unregulated	74,300								
Ovens	High	123	0	0	123	0	123	0	123	0
Broken	High	534	120	0	342	0	462	1,114	1,500	76
	Low	4								
Goulburn	High	126,863	69,951	0	109,658	4,015	183,625	216,053	376,434	23,243
	Low	186,128								
Campaspe	High	27,372	9,760	0	34,044	0	43,804	-3,038	31,294	9,473
	Low	8,409								
	Passing flows	-								
Loddon	High	8,134	2,803	-100	15,324	0	18,027	3,629	18,007	3,650
	Low	2,551								
	Provisional	7,590								
	Passing flows	-								
	Total northern systems		**380,670**	**-52,435**	**823,988**	**664,300**	**1,816,523**	**500,455**	**802,331**	**513,737**
Western systems										
Wimmera & Glenelg	High	40,560	42,552	0	45,129	0	87,681	0	39,678	48,030
	Provisional	1,000								
	Passing flows	-								
	CEWH	28,000								
	Total western systems		**42,552**	**0**	**45,129**	**0**	**87,681**	**0**	**39,678**	**48,030**
Central systems										
Tarago	Share of inflows	10.3%	1,650	-8	1,559	0	3,201	0	1,764	1,437
Yarra	High	17,000	19,734	0	17,000	0	36,734	-25	24,054	12,655
Werribee	Share of inflows	10%	2,024	0	220	1,289	3,534	-186	2,573	775
Maribyrnong [4]	n/a	n/a	0	0	0	0	0	300	290	10
Moorabool	Share of inflows	11.9%	4,923	0	0	0	4,923	485	2,746	2,662
Barwon	Share of inflows	3.8%	0	0	1,000	0	1,000	0	0	1,000
	Unregulated	1,000								

Basin	Entitlement type/ reliability	Entitlement volume at 1 July 2017	Net carryover at July 2017 (a)	Carryover / allocation lost to spill (b)	Seasonal allocation / share of inflows (c)	Return flows [(1)] (d)	Total available (pre trade) (e) = (a)-(b)+(c)+(d)	Net trade in [(2)] (f)	Volume used (g)	Closing balance at 30 June 2018 (h) = (e)+(f)-(g)
	Total central systems		**28,331**	**-8**	**19,779**	**1,289**	**49,392**	**574**	**31,426**	**18,539**
Gippsland systems										
Latrobe	Unregulated	n/a	15,622	0	7,271	0	22,894	0	11,224	11,670
	Share of inflows	9.45%								
Thomson	High + Share of inflows	22,461	17,388	0	32,905	0	50,293	0	33,956	16,337
	Passing flows	6,230								
	Total Gippsland systems		**33,010**	**0**	**40,176**	**0**	**73,186**	**0**	**45,180**	**28,007**
Total			**484,564**	**-52,443**	**929,072**	**665,589**	**2,026,782**	**-499,881**	**918,615**	**608,313**

Notes

(1) 'Return flows' means the volume of water released in-stream under an entitlement and made available for further re-use by the environment at a downstream location.
(2) 'Net trade in' means the net trade to all environmental water holders into the river basin.
(3) The Barmah-Millewa Forest Environmental Water Allocation is included in the Murray basin, as the water could be used during the 2017–18 year.
(4) There are no environmental entitlements in the Maribyrnong basin, however in partnership with Melbourne Water the VEWH purchased 300 ML from entitlement holders in the system.
n/a Not applicable.

4.1.3 Snowy Water Initiative

The Snowy Water Initiative was formally established in 2002 to increase flows in the Snowy River — in response to the impacts the Snowy Mountains Scheme (Snowy Scheme) was having on the river's health — by regulating and diverting large volumes of water west into the Murray–Darling basin. As part of this initiative, the Victorian, New South Wales and Commonwealth governments committed to recovering water from the Murray–Darling basin to increase flows in the Snowy and Murray rivers.

The Victorian Government met its commitment to recover water from the Murray, Goulburn and Loddon systems by 2012. This resulted in the creation of water entitlements, which are now held by the VEWH. Each year, the water allocated to these entitlements at 31 January is transferred to the Snowy Scheme, where it is made available for release into the Snowy and Murray rivers for environmental benefit. These transfers reduce the amount of water Snowy Hydro Limited is required to release from the Snowy Scheme to the Murray in the following year. In accordance with intergovernmental agreements, two-thirds of the withheld water is released to the Snowy River for environmental benefit, and the remaining third provides flows for the environment in the Murray River.

In January 2018, the VEWH transferred a total of 83,813 ML allocation to the Snowy Scheme. This is similar to the volume made available in the previous year (85,911 ML) reflecting similar Victorian allocations in both years. Including contributions from New South Wales, a total of 195,268 ML was transferred to the Snowy Scheme in 2017–18 (

Table 4-5). Of this volume, 130,178 ML was assigned for release to the Snowy River and 65,089 ML to the Murray River.

Table 4-5 Water available under Snowy Water Initiative 2017–18 (ML) [(1)]

Entitlement source	Entitlement volume (ML)	Allocation in 2017–18 (ML)	Allocation in 2016–17 (ML)
Victoria [(2)]	115,939	83,813	85,911
New South Wales [(3)]	192,219	111,455	198,424
Total	**308,158**	**195,268**	**284,334**
Volume apportioned to Snowy River Increased Flows		*130,178*	*214,334* [(4)]
Volume apportioned to Murray River Increased Flows		*65,089*	*70,000*

Notes

(1) The information about the Snowy River entitlements was sourced from the New South Wales Department of Industry.
(2) Includes 83,508 ML high-reliability entitlements and 32,431 ML of low-reliability entitlements.
(3) Includes 52,635 ML high-security entitlements, 115,084 ML general-security entitlements and 24,500 ML conveyance entitlements.
(4) The volume apportioned to Snowy River Increased Flows in 2016–17 was greater than the volume released in 2016–17 due to a 2,500 ML surplus delivery in 2016–17, 2,000 ML of Jindabyne spill payback and 2,334 ML of allocation transferred in excess of the 212,000 ML recovery target.

In 2017–18, water allocation recovered under the Snowy Water Initiative was released for environmental benefit in both the Snowy and Murray rivers. A total 207,100 ML of Snowy River Increased Flows was released to the Snowy River from Jindabyne Dam, in addition to the 8,500 ML base passing flow and 500 ML riparian flow released from Mowamba Weir. A total of 314,000 ML of River Murray Increased Flows (RMIF) was released from the Snowy

Scheme to the Murray system for delivery to meet environmental objectives in the River Murray system downstream of Hume Dam. Victoria's share of RMIF was half the volume (157,000 ML), and it was allocated to the VEWH.

4.2 Obligations on consumptive water entitlements

Obligations on consumptive water entitlements are an important component of water for the environment. Obligations set out arrangements for sustainably managing available water resources to balance the needs of all consumptive users and the environment. Obligations are typically described as passing flows: these are flows that an irrigator or a water corporation must pass at its weir or reservoir before it can take water for other uses. Other obligations on entitlements are documented in statutory and local management plans.

4.2.1 Passing flows on bulk entitlements

Most consumptive bulk entitlements include obligations expressed as 'passing flow requirements'. Passing flow requirements are specified as obligations in bulk entitlements and environmental entitlements. The holders of these entitlements must report on their compliance with these requirements.

No major breach of passing flows compliance was reported in 2017–18. However, two minor failures to meet passing flows requirements occurred, as reported below.

Goulburn-Murray Water was unable to meet passing flow requirements once in 2017–18. Due to maintenance works at Campaspe Weir, the flows were less than the minimum required flow for three days in September downstream of Lake Eppalock. Minimum passing flows not provided were credited to the passing flow account for later use. There were four days of minimum-flow noncompliance during the year, due to fluctuations in calculated inflows.

Western Water was unable to meet the minimum passing flows requirements once. Passing flow requirements on Willimigongon Creek require manual operation and are difficult to operate under most conditions, due to large variations in daily flows. As a result, failures to meet daily passing flow requirements occurred during 2017–18, as they did in 2016–17. This was compensated by ensuring average passing flows over the year exceeded the shortfall. To improve the manual process, telemetry and alarming were introduced in 2017–18 to further improve compliance with passing flow requirements.

4.2.2 Management plans

Obligations on consumptive entitlements are outlined in statutory and local management plans in unregulated river systems:

- **statutory management plans** follow a legislated process to determine how water in a waterway or groundwater system will be shared between consumptive users and the environment in unregulated systems. These plans are developed with the community, water users and other stakeholders and include rules to meet management objectives in the area
- **local management plans** are developed by water corporations for unregulated systems. These plans explain to licensees and the broader community the specific management arrangements for the water resource from which they extract and the rules that apply to them as users of that resource. They also explain how water will be shared in times of shortage. These typically apply in areas where there are no statutory management plans. For groundwater, local management plans are prepared through groundwater catchment statements.

In unregulated river systems, statutory management plans are documented as streamflow management plans. Streamflow management plans will include flow thresholds at which rosters, restrictions and bans on the water taken from streams by licensed diverters. Rosters and restrictions set out the order in which licence holders are allowed to take water and the quantity allowed to be taken (for example, 75% of licensed volume). When water is particularly scarce, bans on diversions from waterways are imposed. There were a number of streams on restrictions and bans in 2017–18. A peak of 138 were on restrictions in March 2018, much higher than the 94 in the previous year. See chapter 2.5.3 for more information.

In 2017–18, there were eight streamflow management plans (SFMPs) in place in Victoria (Table 4-6). Seven SFMPs were in place in the Yarra basin. There was also a management plan for the upper Ovens River in the Ovens basin. The *Upper Ovens River WSPA Water Management Plan* provides for integrated management of surface water and groundwater. It is the only integrated management plan developed in Victoria so far.

Table 4-6 Status of streamflow management plans

Basin	Stream(s)	Status	Responsible authority
Ovens	Upper Ovens River (above Myrtleford)	Integrated surface water and groundwater management plan approved and operational. A review was completed in 2017–18.	Goulburn-Murray Water
Yarra	Hoddles Creek, Plenty River, Pauls / Steels / Dixons creeks, Stringybark Creek, Woori Yallock Creek and Little Yarra and Don rivers	Streamflow management plans approved and operational	Melbourne Water
	Olinda Creek	The Olinda Creek streamflow management plan was amended in May 2018.	

Compliance with each approved SFMP is reported annually by the relevant water corporation to the Minister for Water and the relevant CMA. Melbourne Water is responsible for managing and implementing the seven SFMPs that are in effect, and information about compliance is available on the Melbourne Water streamflow management website page.

Goulburn-Murray Water is responsible for the management and implementation of the integrated *Upper Ovens River WSPA Water Management Plan*, and information about compliance is reported in the *Upper Ovens River WSPA Water Management Plan* annual report available on the Goulburn-Murray Water website.

Water for the environment is not restricted to surface water and can include groundwater. An amendment in 2005 to the *Water Act 1989* established the environmental water reserve, to sustain the long-term health of our rivers and groundwater systems. Water for the environment can include rules that restrict groundwater extraction when aquifer levels reach specified triggers, to protect the environment.

Groundwater is managed through a range of actions to ensure sustainable and equitable sharing of the resource. Statutory and local management plans outline the obligations for consumptive groundwater users including restrictions or rosters. In 2017–18, there were four GMUs subject to restrictions initially, with Katunga restrictions lifted towards the end of October 2017. There were four GMUs subject to restrictions in 2016–17. See chapter 2.5.4 for more information.

In 2017–18, statutory management plans were in place in eight WSPAs (Table 4-7). The amendment process for the *Katunga WSPA Groundwater Management Plan* was completed by the consultative committee in June 2017 following an extensive consultation process. The *Katunga WSPA Groundwater Management Plan* was approved by the Minister for Water in August 2017.

Table 4-7 Status of statutory management plans in groundwater catchments in 2017–18

Groundwater catchment	Water supply protection area	Status	Responsible authority
Goulburn-Broken	Katunga	Amended in June 2017	Goulburn-Murray Water
Loddon	Loddon Highlands	Approved in November 2012	Goulburn-Murray Water
Campaspe	Lower Campaspe Valley	Approved in October 2012	Goulburn-Murray Water
Ovens	Upper Ovens	Approved in January 2012	Goulburn-Murray Water
Wimmera	Murrayville	Process underway to abolish WSPA status and local management plan has almost been completed	Grampians Wimmera Mallee Water
Westernport	Koo Wee Rup	Approved August 2010	Southern Rural Water
Hopkins-Corangamite	Warrion	Approved August 2010	Southern Rural Water
Seaspray	Yarram	Approved October 2010	Southern Rural Water

Compliance with each approved statutory management plan is reported annually by the relevant water corporation to the Minister for Water. The relevant water corporation also publishes local and statutory management plans on their websites. Authorities with plans currently in place are:

- Goulburn-Murray Water:
  - https://www.g-mwater.com.au/water-resources/surface-water/unregulated-local-management-rules
  - https://www.g-mwater.com.au/water-resources/ground-water/management
- Southern Rural Water:
  - http://www.srw.com.au/ via > Publications > Rivers and Creeks Management Rules and Plans
  - http://www.srw.com.au/ via > Publications > Groundwater management rules and plans
- Grampians Wimmera Mallee Water: https://www.gwmwater.org.au/about-us/annual-reports.

4.3 Above cap water

Above cap water is the volume of water available above the volume allocated to water entitlements. For the Victorian water accounts, this is calculated as the difference between the total inflow to a river basin and the total volume flowing out of the basin.

Figure 4-1 shows the proportion of inflows to all Victorian river basins to the volume flowing out of Victoria for the last 15 years. The proportion of flows leaving Victorian river basins is not in itself a reliable indicator of river health, due to the complex interaction of ecological processes and seasonal variability of streamflow.

Figure 4-1 Volume leaving Victorian river basins, as proportion of total flows, 2003–04 to 2017–18

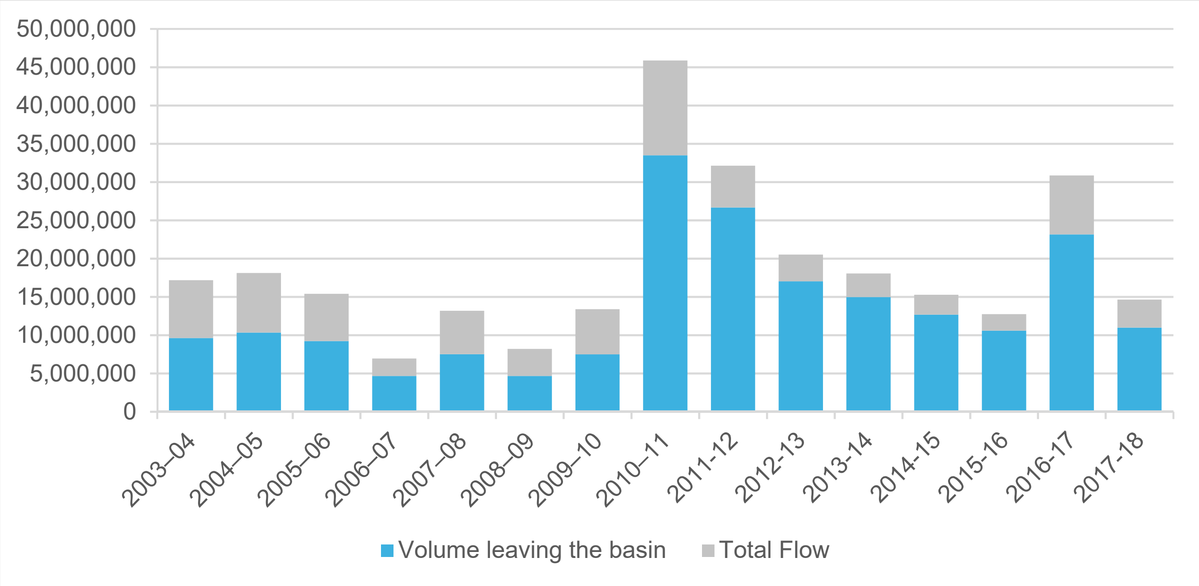


Table 4-8 shows the above cap water for each basin by reporting the total amount of water in each basin together with the amount of water that leaves the basin after water is extracted for consumptive use. The above cap water is expressed as a proportion of the annual flows of water that could have left the basin if there were no diversions. The reduced rainfall and streamflows experienced across much of the state in 2017–18 meant that the above cap water as a total volume of water leaving Victoria's river basins was lower than the previous year (10,975,259 ML, compared to 23,144,298 ML in 2016–17). As a percentage of total inflow volume, the water reaching the basin outlets was also lower than the previous year, with 61% reaching the basin outlets in 2017–18 (Table 4-8).

In 2017–18, the proportion of total flows leaving the basin increased in 11 of the basins and decreased in 17, compared to 2016–17 (Table 4-8). The basins that experienced the lowest proportions of water leaving the basin as a percentage of total flows in 2017–18 were the Avoca (0%), Moorabool (17%), Thomson (35%), Loddon (47%) and Goulburn (50%) basins. The proportion of annual flows leaving the basin was 90% or above in 13 basins, predominantly in the south of the state, similar to 2016–17. Although the Campaspe and Snowy basins recorded the highest proportion of total flows leaving the basin in 2017–18, the volume was lower than in the previous year.

Table 4-8 Volume leaving Victorian river basins, 2017–18

Basin	Outflow to	2017–18			2016–17		
		Total flow if no diversions (ML)	Volume leaving the basin (ML)	Proportion of total flow leaving the basin (%)	Total flow if no diversions (ML)	Volume leaving the basin (ML)	Proportion of total flow leaving the basin (%)
Murray (1)	South Australia	3,808,139	2,482,325	65%	9,837,093	5,486,540	56%
Kiewa (2)	Murray River	555,981	511,744	92%	1,092,663	1,030,388	94%
Ovens	Murray River	1,004,579	954,533	95%	2,897,252	2,840,625	98%
Broken	Murray River	100,536	78,736	78%	543,022	477,075	88%
Goulburn	Murray River	1,843,383	930,014	50%	3,170,647	1,748,844	55%
Campaspe	Murray River	15,566	94,395	606%	445,441	153,801	35%
Loddon	Murray River	73,071	34,107	47%	575,122	292,707	51%
East Gippsland	Bass Strait	152,362	151,596	99%	590,896	589,741	100%
Snowy (Vic. only) (3)	Bass Strait	509,900	754,931	148%	1,691,959	2,096,630	124%
Tambo	Gippsland Lakes	52,891	50,229	95%	358,443	352,334	98%
Mitchell	Gippsland Lakes	417,895	396,799	95%	1,060,803	1,040,558	98%
Thomson	Gippsland Lakes	546,937	193,893	35%	962,204	621,942	65%
Latrobe	Gippsland Lakes	492,415	401,559	82%	636,930	525,405	82%
South Gippsland	Bass Strait, Western Port	694,156	662,949	96%	835,065	790,595	95%
Bunyip	Bass Strait, Western Port, Port Phillip Bay	622,285	562,303	90%	622,285	562,303	90%
Yarra (4)	Port Phillip Bay	599,650	346,945	58%	751,382	471,143	63%
Maribyrnong	Port Phillip Bay	23,764	19,455	82%	136,619	114,030	83%

Basin	Outflow to	2017–18			2016–17		
		Total flow if no diversions (ML)	Volume leaving the basin (ML)	Proportion of total flow leaving the basin (%)	Total flow if no diversions (ML)	Volume leaving the basin (ML)	Proportion of total flow leaving the basin (%)
Werribee	Port Phillip Bay	16,850	9,263	55%	128,564	61,005	47%
Moorabool	Port Phillip Bay	49,122	8,279	17%	105,837	44,205	42%
Barwon	Port Phillip Bay, Bass Strait	145,604	108,953	75%	335,884	289,383	86%
Corangamite (4)	Corangamite Lakes	282,560	281,102	99%	388,612	375,704	97%
Otway Coast	Bass Strait	844,092	816,839	97%	938,488	905,374	96%
Hopkins	Bass Strait	239,832	230,430	96%	550,033	509,134	93%
Portland Coast	Bass Strait	344,469	341,673	99%	505,276	498,432	99%
Glenelg	Bass Strait	617,198	526,162	85%	1,336,754	1,036,754	78%
Millicent Coast (5)	South Australia	-	-	-	4	-	-
Wimmera (4)	Lakes Hindmarsh and Albacutya	32,478	26,044	80%	347,538	191,753	55%
Mallee (5)	Murray River	-	-	-	-	-	-
Avoca (6)	Lake Bael Bael and the Marshes	3,366	0	0%	62,597	37,894	61%
Total		**14,089,082**	**10,975,259**	**78%**	**30,907,414**	**23,144,298**	**75%**

Notes

(1) This table includes only the Victorian component of Murray basin streamflows and Victoria's contribution to the environment's share of total flows. In this case, the environment's share is taken to be Victoria's contribution to flows at the Victorian-South Australian border.

(2) Includes the New South Wales share of Kiewa River flows under the Murray–Darling Basin Agreement.

(3) The total flow volume relates to the flows from the Victorian tributaries of the Snowy River only. Volume leaving the basin relates to all water flowing from the Snowy River into Bass Strait, which includes water originating from the New South Wales portion of the Snowy River.

(4) Transfers of water into this basin are not included in the total flows.

(5) For the purpose of this table, flows leaving the basin are taken as flows entering the terminal lakes.

(6) There are no significant streams in this basin.

5. Water trade

Water-trading is the process of buying, selling or exchanging rights to water. Water trade is used as a tool to facilitate the efficient use of water resources. While unofficial trade was likely occurring as early as the 1940s, official temporary trades first occurred in 1987 and official permanent trades first occurred in 1991–92.

The ability to report on trade allows the examination of how availability and demand for water influences its movement and efficient use in Victoria. This chapter reports on trade activity during the 2017–18 water year, the volume of water traded and the movement of the water traded.

Further information about water-trading in Victoria is provided in the *Victorian Water Trading 2017–18 Annual Report*, available at waterregister.vic.gov.au (search 'Trade reports Victorian water register').

5.1 Victoria's water trade framework

Trade of water in Victoria is governed by trading rules and policies set by the Minister for Water. The rules and policies aim to facilitate trade wherever possible, while minimising negative impacts on other users and the environment.

Trade can be a permanent transfer of ownership of a water entitlement (the ongoing right to water), or trade of allocation (the physical water available in a given year). There are four main avenues for trading water in Victoria. For declared systems, there is trade of allocation and trade (or transfer) of water shares. In non-declared systems, trade may involve 'entitlement volume trade' between licences or the 'change of ownership' of a licence due to land ownership change.

5.1.1 Allocation trade

Allocation is water available each season under water entitlements. Water is allocated based on the available resource in any given year (see chapter 2.5.2 for information about allocations in 2017–18).

The allocation made against a water entitlement may be traded separately from the water entitlement and from the land title. Allocation trade can occur either within a trading zone or between trading zones, in line with the trading rules for declared water systems.

Allocation trade includes trade of allocation made available under water shares and bulk entitlements. Most allocation trade occurs in declared water systems. In northern Victoria, these are the Broken, Bullarook, Campaspe, Goulburn, Loddon, Murray and Ovens systems; and in southern Victoria, the Thomson–Macalister and Werribee systems. In other parts of the state, trade of allocation available under bulk entitlements may also occur.

Environmental water holders also use allocation trade to move water between different environmental water accounts.

5.1.2 Trade of water shares

As explained in chapter 1, a water share is a legally recognised, secure entitlement to a share of the water available for use in a declared water system. Trade of water shares can mean a transfer of ownership from one person to another, a change of the location where the water share is used, or both. This chapter provides summary information about transfers of ownership of water shares.

More-detailed reporting on the movement of water shares within, into or out of different water delivery systems in Victoria is provided in the Victorian water trading annual report. Movement occurs with:

- a change of ownership (when there is a change in the named holder of the water share; this could occur for the new owner to have the right to be issued allocation)
- an association or variation of the water share (when an existing owner wishes to vary the allocation account that the water share is linked or the works that are associated with the water share).

5.1.3 Trade of take and use licences

Outside declared water systems, take and use licences allow water to be taken from either unregulated surface water systems or from groundwater to be used on the land defined in the licence. Trading of take and use licences is subject to the requirements of the *Water Act 1989*, the ministerial policies for managing take and use licences and any approved local management rules or plans.

Transfer of entitlement volume for a take and use licence can be either a 'permanent volume transfer' or a 'temporary volume transfer' to transfer part or all of the volume from one licence to another. Such transfers usually include a change in location. The other type of transfer is 'change of ownership', which changes the ownership of a licence due to a land ownership change without affecting the volume and location of the licence.

In this chapter, unregulated surface water trades and groundwater trades are reported separately.

5.2 Overview of trade in 2017–18

5.2.1 Allocation trade

A total of 3,335,696 ML of allocation was traded in Victoria in 2017–18, an increase on 2016–17 when 2,759,935 ML was traded. Most of this occurred in northern Victoria (3,317,012 ML) with small volumes in southern Victoria (18,236 ML) and western Victoria (448 ML).

The growth in allocation trade in northern Victoria shows an increased reliance on the trade to meet water requirements and to manage accounts for commercial purposes and the environment. Figure 5-1 shows that there has generally been an increasing trend since 2007-08.

The volume of trade in northern Victoria in 2017–18 was influenced by the availability of unused water in the connected southern Murray–Darling basin and the use of trading to manage accounts going into 2018–19. During 2017–18, there were hotter-than-average temperatures throughout the year and during the main irrigation period (November 2017 to April 2018). Rainfall was also below average over a wide area of northern Victoria for the year and average to below average in the Goulburn-Murray region for the same period.

As in previous years, environmental trades made up a significant portion of the volume traded in 2017–18: there was 1,405,860 ML of within-environment allocation trade in northern Victoria (Table 5-1), which equates to 42% of the total volume traded. For information about the assumptions made to distinguish between environmental and consumptive trading, see the *Victorian Water Trading 2017–18 Annual Report*.

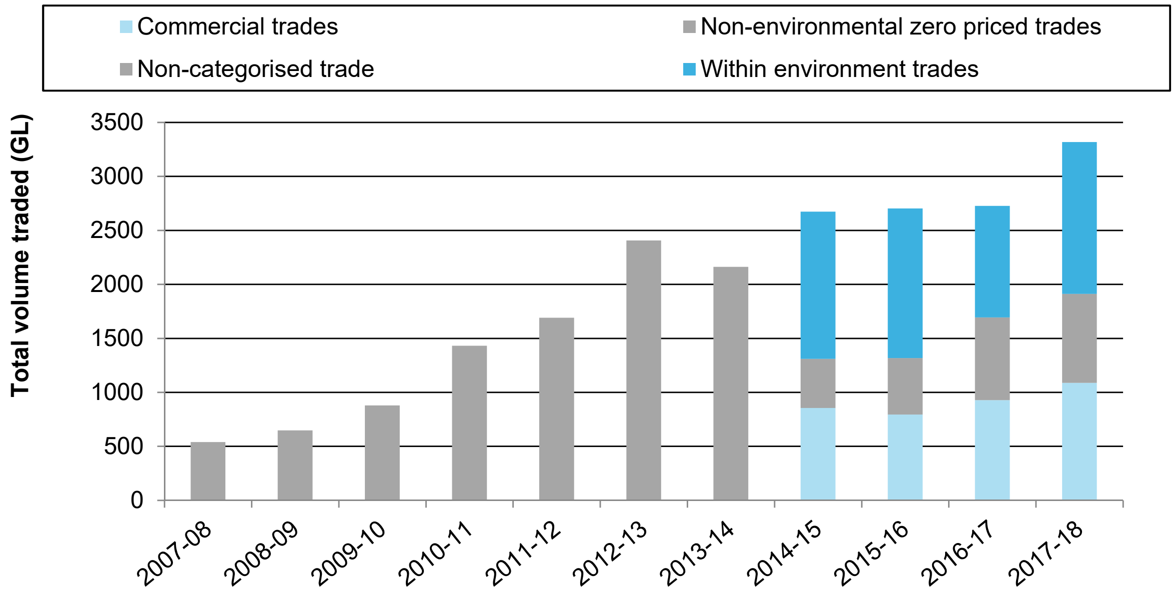
Table 5-1 Summary of trade of seasonal allocation trade in Victoria

Trade type	2017–18		2016–17	
	Number of trades	Volume (ML)	Number of trades	Volume (ML)
Northern Victoria				
Commercial trades	10,454	1,087,683	7,571	927,925
Zero-priced allocation trades	5,059	823,469	4,518	766,091
Within-environment trades	83	1,405,860	68	1,032,196
Northern Victoria subtotal	***15,596***	***3,317,012***	***12,157***	***2,726,213***
Southern Victoria				
Commercial trades	123	5,961	91	4,901
Non-commercial trades	235	12,275	244	21,066
Southern Victoria subtotal	***358***	***18,236***	***335***	***25,968***
Western Victoria				
Commercial trades	3	448	4	7,754
Western Victoria subtotal	***3***	***448***	***4***	***7,754***
Total	**15,957**	**3,335,696**	**12,496**	**2,759,935**

Across the state, trades of environmental water represented a large proportion of the volume traded. The VEWH uses trade to move water between areas across Victoria, depending on its environmental watering plan.

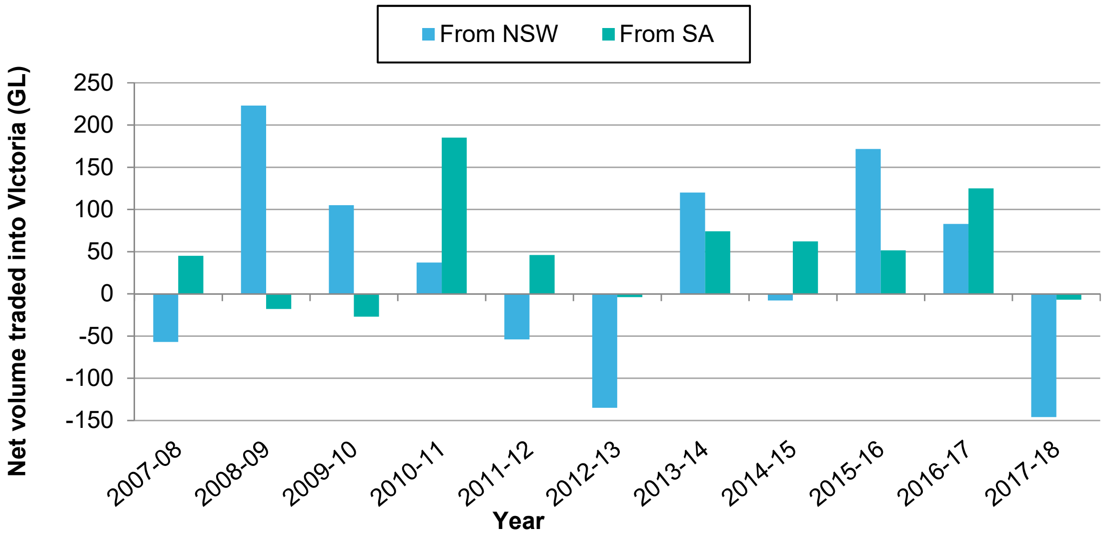
Commercial trades, where allocation is sold for a specified price, represented 1,087,683 ML of the total volume of allocation water traded in northern Victoria. Zero-priced trades, where water is traded from one account to another without payment, represented about 25% of the total volume traded (Figure 5-1). These trades may include trades between accounts owned by the same person or between related parties. The proportion of trade applications received without price information has reduced in recent years, enabling greater confidence in this type of more-detailed market analysis.

Figure 5-1 Volume of allocation trade in northern Victoria, 2017–18



Water trade between Victoria, New South Wales and South Australia is permitted, subject to trading rules. Excluding trade within environmental accounts, there was a total of 89,734 ML traded into Victoria (43,360 ML commercially) in 2017–18 and 243,212 ML traded out of Victoria (142,086 ML commercially), resulting in an overall net trade out of Victoria of 153,478 ML (Figure 5-2).

Figure 5-2 Net volume of allocation trade into Victoria from New South Wales and South Australia (excluding within-environment trade), 2017–18



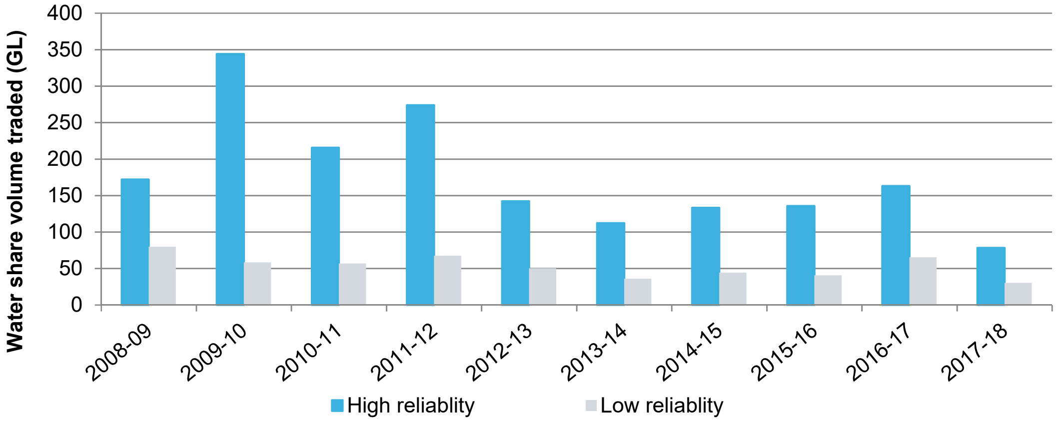
5.2.2 Water share transfers

Water share trade across Victoria in 2017–18 included 78,288 ML of high-reliability and 30,397 ML of low-reliability water shares transferring ownership (Table 5-2 and Figure 5-3). As with allocation trade, most of this occurred in northern Victoria, with a small amount in southern Victoria.

Table 5-2 Water share transfers in Victoria

Water share type	2017–18		2016–17	
	Number of trades	Volume (ML)	Number of trades	Volume (ML)
High reliability	2,001	78,288	2069	163,157
Low reliability	622	30,397	813	65,501

Figure 5-3 Transfer of ownership of water shares in Victoria, 2017–18



5.2.3 Unregulated surface water

Surface water take and use licence trading during 2017–18 resulted in 1,737 ML of water permanently traded and 5,472 ML of water temporarily traded. Unlike allocation and water share trading, most of the surface water take and use licence trading occurred in southern Victoria, with 882 ML of permanent trade and 4,157 ML of temporary trade. Significantly lower volumes were traded in northern Victoria, and almost no take and use licence volume was traded in western Victoria, except as part of land transfers.

As shown in Table 5-3, trade in surface water take and use licences was much lower than the trade in groundwater take and use licences. Trades as part of land transfers (take and use licence change of ownership) are the dominant trade type, by volume of water in surface water trades.

Table 5-3 Trade of surface water take and use licences in Victoria

Region	Temporary trade		Permanent trade		Trade as part of land transfer	
	Number	Volume (ML)	Number	Volume (ML)	Number	Volume (ML)
North	49	1,315	75	855	221	3,552
South	119	4,157	42	882	183	8,275
West	-	-	-	-	7	31
Total 2017–18	**168**	**5,472**	**117**	**1,737**	**411**	**11,858**
Total 2016–17	127	3,920	83	2,528	523	10,195

5.2.4 Groundwater

The volume of temporary and permanent groundwater take and use licence trading was higher in 2017–18 than in the previous year, with 18,206 ML of temporary trade (compared to 10,662 ML in 2016–17) and 5,278 ML of permanent trade (compared to 4,323 ML in 2016–17).

Table 5-4 shows that in 2017–18, trades of groundwater take and use licences were mostly part of land transfers (take and use licence change of ownership) with 304 trades amounting to about 39,837 ML.

Table 5-4 Trade of groundwater take and use licences in Victorian groundwater management units

Region	Temporary trade		Permanent trade		Trade as part of land transfer	
	Number	Volume (ML)	Number	Volume (ML)	Number	Volume (ML)
North	56	6,840	31	2,397	138	22,727
South	111	7,451	58	2,256	155	13,379
West	20	3,915	2	625	11	3,731
Total 2017–18	**187**	**18,206**	**91**	**5,278**	**304**	**39,837**
Total 2016–17	117	10,662	63	4,323	311	45,100

Part 2: Water accounts 2017–18

Part 2 of the *Victorian Water Accounts 2017–18* presents an account of surface water, groundwater and distribution systems in Victoria for 2017–18.

Chapter 6 provides the water accounts for each of Victoria's 29 river basins and includes:

- a map of each river basin
- a basin overview including summaries of information presented in each basin, management responsibilities in the basin and where applicable information about water for the environment
- the total water resources in each basin
- detailed information about surface water entitlements in the basin
- detailed information about the use of surface water and recycled water in the basin.

The basin water accounts presented in Chapter 6 track surface water from the time it appears as inflows to a waterway to the time it is diverted from the surface streams of the basin, or flows from the basin to another basin or to the sea.

Chapter 7 provides the water accounts for each of Victoria's 20 groundwater catchments and includes:

- a map of each groundwater catchment
- an overview of groundwater resources and management responsibilities in each catchment
- detailed information about licensed entitlements and unlicensed stock and domestic bores (private rights to water) as well as groundwater use in the catchment.

The groundwater catchment accounts presented in Chapter 7 help to describe Victoria's groundwater resource and track groundwater extracted for irrigation, urban and domestic and stock use.

Chapter 8 provides the accounts for all of Victoria's rural and urban distribution systems. While Chapter 6 and Chapter 7 describe the entitlements and use of water taken from river basins and groundwater catchments, Chapter 8 describes the movement of this water through the constructed distribution systems that deliver water to users. These accounts track the water from the time it moves from a waterway, an aquifer or other source to the time it is delivered to a customer or another destination.

Distribution systems typically supply end users within irrigation districts or towns and urban areas. Some infrastructure services both of these end uses. On occasion, environmental entitlements are supplied using the distribution systems. Providing water accounts for distribution systems enables water corporations and the community to understand where delivery-efficiency improvements to reduce losses can most readily be made.

6. River basin accounts

6.1 Methodology

6.1.1 Introduction

This chapter outlines the basis for the information presented in the river basin accounts. It explains some important assumptions and limitations of the data in the accounts, which should be read in conjunction with the information in the basin accounts.

The river basin accounts are compiled from information obtained from:

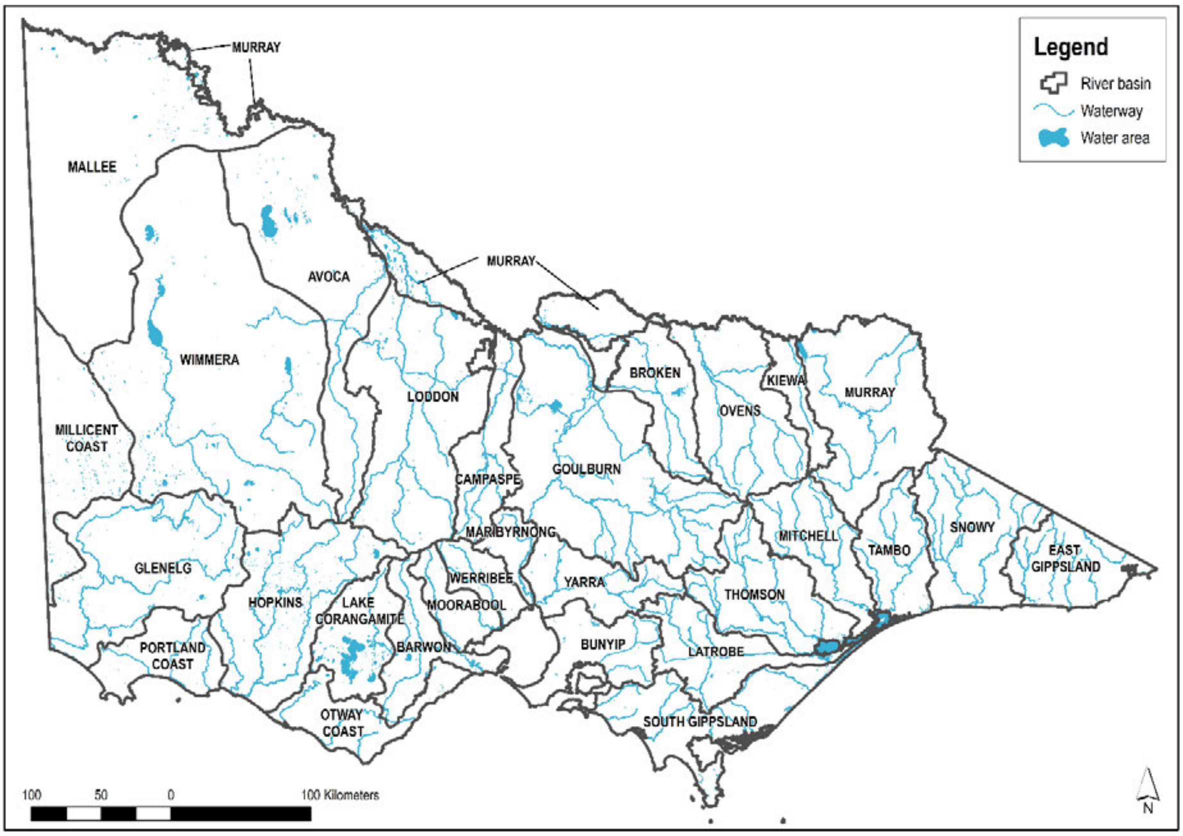
- responses to requests for data from water corporations, the VEWH, DELWP, major users of water and the MDBA
- water consumption and recycled water data collected from water corporations by the Essential Services Commission
- hydrologic information from selected streamflow monitoring sites
- climate information from selected rainfall and evaporation monitoring sites provided by the Australian Bureau of Meteorology and water corporations
- estimated relationships between water use and climate or hydrologic data, which is produced by water supply system modelling, held by DELWP
- water corporations' annual reports and related documents.

All information for each of the 29 river basins is provided for the period 1 July 2017 to 30 June 2018. River basin boundaries are shown in Figure 6-1. Responsibilities for water management are reported in the accounts as they were in 2017–18. Any changes to responsibilities since the end of June 2018 will be reported in future water accounts.

Surface water data generally aligns well with river basin boundaries, except where water is diverted from a waterway in one river basin and is then used in another. For the purposes of the basin water accounts, water is accounted for at the point of diversion from the waterway and not at the point of use. For example, information about diversions to supply the Rochester Irrigation Area, located at the downstream end of the Campaspe basin, is accounted for in the Goulburn basin where the source of supply is located.

Towns with wastewater treatment plants have been assigned to river basins according to the point of discharge from the plant into the receiving waters. If all water is reused and none is discharged into waterways, the treatment plant is assigned to a basin according to the location of the plant.

Figure 6-1 River basin boundaries



6.1.2 Continuous improvement of the Victorian water accounts

Three main improvements have been made for the 2017–18 accounts:

- a review was conducted of the methods used to estimate in-stream losses
- the method to estimate harvesting, use and losses from small catchment dams was updated
- estimates of long-term water availability were updated (see chapter 2.2).

Review of models used to estimate in-stream losses

In-stream losses — also known as in-stream infiltration to groundwater, flows to floodplain and evaporation — have been estimated in the accounts using streamflow data and water resource models. These models and the streamflow data were reviewed by consultants in 2019, to ensure the best-available data and models were being used to estimate losses.

The review also investigated if there were any models available for basins where no suitable model existed to estimate in-stream losses: these are the East Gippsland, Snowy, Tambo, Latrobe, South Gippsland, Yarra, Corangamite, Otway Coast, Hopkins and Portland Coast basins. The review found that no new models existed. Consultants determined that in the absence of suitable water resource models, in-stream losses could be calculated using water balances. However, this would require streamflow data at the source and outlet of each major river. Although there are a reasonable number of gauged locations across the basins, their distribution means that deriving comprehensive estimates of in-stream losses is not possible. This does not mean there are no in-stream losses in these basins, rather that they cannot be estimated using currently available models or as the balancing item in the water balances.

The following changes to the calculation method were recommended and implemented in these basins.

- The Werribee basin had the biggest reduction in estimated in-stream loss in proportional terms, because loss estimates for three reaches were reduced to zero when the REALM model was updated in 2018.
- The largest increase in a loss estimate was in the Ovens basin. The estimate has changed from a constant value reported each year — 14,936 ML — to a function of streamflow. The estimate now also includes losses in Reedy Creek and the unregulated part of the Ovens River.
- Scaling the streamflow record used to estimate losses in the Bunyip basin to account for all inflows to Tarago Reservoir has increased the estimated losses by 22%.
- Using the loss functions from recently updated REALM models has reduced in-stream loss estimates in the Wimmera and Kiewa basins by 5% and 17% respectively, and increased in-stream loss estimates in the Barwon, Moorabool, Maribyrnong and Thomson–Macalister basins by 6%, 5%, 11% and 7% respectively.
- The estimated losses for the Loddon basin have also increased, because in-stream losses downstream of Loddon Weir are now being accounted for.

Updated small catchment dam estimates

Small catchment dams are dams that are not located on a defined watercourse but harvest water from their local catchment. The presence of small catchment dams changes the hydrology in a basin by reducing the rate of overland flows (that is, surface run-off) and by altering evaporation and groundwater seepage. Small catchment dams reduce the volume of surface run-off that might otherwise become streamflows in a basin.

In the Victorian water accounts before 2015–16, the total volume of water harvested by small catchment dams was determined using estimates of the total volume of small catchment dams in a basin obtained from DELWP's Sustainable Diversions Limits Project in 2002 and the Flow Stressed Ranking Procedure Project in 2005, and from computer-based simulation modelling of the impact of small catchment dams on mean annual streamflows.

In the *Victorian Water Accounts 2015–16*, the GIS data used to derive the capacity values for small catchment dams was updated to provide a more-accurate measure. The key differences with previous years included improved identification of small catchment dams with very small (less than 5 ML) capacities and an improved ability to differentiate small catchment dams from other small water bodies (such as natural lakes or wetlands). This method was used again in 2016–17.

In these *Victorian Water Accounts 2017–18*, the method used to estimate the usage, evaporation and harvested volumes from small catchment dams has been improved. The key difference is that each dam identified in the GIS data has been individually modelled, to better reflect the water balance around the dam based on the climate for that year. There is more information about this new method in Appendix E.

Further methodological updates will be implemented in future years, as modelling techniques and data improve.

Estimated small catchment dam impacts are represented in the river basin water balances as three separate components. They are:

- the estimated volume harvested by small catchment dams in each basin, which appears as catchment inflow in the water balance
- the estimated volume that owners extract from dams to supply their needs, which is accounted for as a diversion in the surface water balance
- the estimated volume of evaporation (less rainfall) from the surface of small catchment dams, which is also accounted for as a loss in the surface water balance.

Updated estimates of long-term water availability

As part of the LTWRA, a technical assessment was undertaken in 2019 to identify changes in surface water availability. The technical assessment refined the original estimates of long-term water availability — also known as long-term average inflows — using improved data and methods and a period that better represents the current climate. Previously, estimates of long-term water availability were calculated as the average annual volume of water available over the entire period for which historical data for measured or modelled streamflow was available for that basin. The **new** estimates of LTA inflows are now based on data from 1975 to the present.

The **new** LTA inflows figure has not been applied in the Bunyip, Corangamite, Glenelg, Otway Coast and South Gippsland basins. The gauges used in these five basins to determine the new LTA inflows are different to those used to calculate the total inflows in 2017–18. For these basins, the old long-term water availability estimate — the **old** long-term average annual streamflow —has been applied in these accounts. Further work will be completed for these basins to update the estimates in future accounts.

See chapter 2.2 for more information about the LTWRA.

6.1.3 Surface water resources

Information about surface water in 2017–18 is presented in this chapter for each of the 29 river basins. The structure of the chapter has been updated this year, and there are now four subchapters within each river basin chapter:

- management arrangements
- 2017–18 water resources overview
- water balance
- compliance against entitlements.

6.1.4 Management arrangements

This subchapter details the relevant organisations in each basin and their management responsibilities.

6.1.5 2017–18 water resources overview

This subchapter provides a snapshot of the water resource in the basin for 2017–18. It summarises the rainfall received, catchment inflows and storage levels, seasonal allocations, restrictions and water use.

Rainfall

The percentage of rainfall received in each basin is estimated from the Bureau of Meteorology's rainfall map (Figure 2-3 in chapter 2.1), which determines the percentage of long-term average rainfall received in Victoria for 2017–18.

Catchment inflows and storage levels

Catchment inflows from the water balance are compared to the long-term average inflow (chapter 2.2) for each basin, along with the starting and ending storage volumes for the year. A chart is also presented in each basin that plots catchment inflows, long-term average inflows and the total capacity and volume of water held in major storages including both off- and on-stream storages in the basin for the past 10 years.

Seasonal allocations, restrictions and water use

Any seasonal allocation determinations (chapter 2.5.2), urban restrictions (chapter 2.5.1) or licensed diversion restrictions (chapter 2.5.3) that applied during 2017–18 are detailed here, along with a summary of consumptive uses from the water balance and water for the environment.

6.1.6 Water balance

The surface water balance is the principal water accounting tool in the Victorian water accounts. The water balance provides a statement of the water flows in a basin for a specified year, in which the sum of the outflows from the area equals the sum of the inflows less the water accumulated in the area (that is, water in storages). The structure of this subchapter has been revised in 2017–18. The water balance table remains unchanged and is presented first with a new Notes column. Any notes are then described in detail in their own section, below the water balance.

A surface water balance is presented for all basins except the Mallee basin and Millicent Coast basin. A lack of significant surface water resources in these basins means there is insufficient data available to prepare a water balance.

The three components of the water balance — major on-stream storages, inflows, outflows — are further explained below.

6.1.6.1 Major on-stream storages

The overall change in storage volume in a basin for the year is provided as the difference between the volume in storage at the start of the year and the end of the year. In general, only on-stream storages with a total capacity larger than 1,000 ML are included in this component of the water balance. While storages that are less than 1,000 ML are important locally, they are generally not material to the total volume of water at a basin and statewide level. Note that the volume of water in off-stream storages is not reported in the surface water balance because this would in some instances result in double counting water that has been diverted from rivers or extracted from groundwater.

6.1.6.2 Inflows

Inflows are the volume of water flowing into waterways within a basin. The inflow components included in the water balance — catchment inflow, rainfall on major storages, transfers from other basins, return flow from irrigation and treated wastewater discharged back to river — are further explained below.

Catchment inflow: this item represents the total volume of surface run-off from rainfall that becomes streamflow into the basin or is captured by small catchment dams. This is generally the unaccounted-for item in each water balance, that is it is calculated as a balancing item. Catchment inflows are determined to be the difference between the total outflows and the known inflows plus accumulated storage volume. The only exception to this is the Murray basin. In the Murray basin, this item represents known inflows, which include Victoria's share of inflows to Lake Dartmouth, Lake Hume and the Menindee Lakes, Victoria's share of inflows from the Kiewa River and inflows from other Victorian basins (Ovens, Goulburn, Broken, Campaspe and Loddon) into the Murray River. It also includes estimated inflows to small catchment dams in the Murray basin.

In addition to the above, the estimated volume harvested by small catchment dams in each basin makes up part of the catchment inflow volume in the water balance. This is determined by calculating the water balance around each individual dam, based on the annual climate including inflows, extractions, rainfall and evaporation. The total volume harvested is the difference between dam inflows and outflows. Aggregating volumes harvested by dams across each basin, this estimates how much water is harvested by small catchments over the course of a year.

Rainfall on major storages: this item represents inflows from rain falling directly on major on-stream storages. Estimates are based on rainfall data and the surface area of storages. Information about storages in each basin with storages is presented in the notes below the balance including the capacity, starting and ending volume in store, rainfall and evaporation. An amount representing catchment inflows less regulated releases is also provided. This volume is the balancing item for each storage and represents the flows of water into or out of the storage that are not shown as rainfall or evaporation, and it includes major and minor components influencing the change in storage during the year.

Transfers from other basins: transfers from other basins are included in a basin's water balance only where these transfers are known to affect streamflows in the receiving basin. These transfers (for example, to rivers or on-stream storages) are included principally because the volume may contribute to the in-stream loss and/or outflow components of the water balance. If water transferred across basin boundaries is supplied directly into a distribution/reticulation system and does not affect streamflows, it is considered as a diversion to an end use (for example, urban and irrigation district diversions) and is not accounted for as a transfer in the water balance.

Return flow from irrigation: return flow from irrigation are the outfalls from an irrigation system that return to waterways. These outfalls arise as part of the normal operation of systems that rely on delivering water by gravity. Return flows from power stations and major industry are also included in the water balance for the Latrobe basin.

Treated wastewater discharged back to river: this item represents the volume of water discharged from wastewater treatment plants back into waterways as part of the water recycling process. Recycled water from towns with wastewater treatment plants has been assigned to basins according to the point of discharge to the receiving waters. If all water from a treatment plant is reused and none is discharged to rivers or lakes, the volume is reported in the basin where the plant is located. A table in each basin chapter provides information about:

- the volume of wastewater produced (excluding evaporation)
- the total volume recycled
- the percent recycled: this excludes 'within plant process', which refers to water reused in sewage treatment processes (for example, to back-flush filters). This value is not included in the total percentage recycled, consistent with its treatment in the Essential Services Commission's performance report
- a breakdown into the following end-use categories:
    - the volume recycled for urban and industrial uses
    - the volume recycled for agricultural uses
    - the volume recycled for beneficial allocations, which refers to the volume used to deliver specific environmental flows benefits
    - the volume recycled within plant process, which refers to water reused in wastewater treatment processes (for example, to maintain biological processes or back-flush filters). This value is not included in the total 'Percent recycled', consistent with its treatment in the Essential Services Commission's performance report
    - the volume discharged to the environment (ocean outfalls or inland water discharges)
    - the volume of other discharges, which refers to a change in on-site effluent storage or other minor items affecting the annual water balance for recycled water that are not otherwise accounted for.

6.1.6.3 Outflows

This term represents water that has left a waterway, whether by natural processes (such as evaporation and seepage), by being diverted by water corporations and individuals or by being passed at the outlet of the basin. The outflow components included in the water balance — diversions, losses and water passed at outlet of basin— are further explained below.

Diversions include water that is deliberately diverted from a waterway to meet a specific use and includes the following.

- **Urban diversions:** this item represents the total volume of water diverted from waterways by water corporations to supply urban customers.
- **Irrigation district diversions:** this item represents the bulk volume of water diverted from waterways by rural water corporations to supply customers in declared irrigation districts.
- **Licensed diversions from regulated or unregulated streams:** this item represents the volume of water diverted directly from waterways by licence holders. Licensed diversions occur where the extraction and delivery of water to a property from a watercourse is the responsibility of the licence holder. Information about licensed diversions is reported separately for regulated and unregulated water sources. Domestic and stock water users are assumed to divert their full entitlement volume, unless otherwise reported by water corporations. The water balance excludes diversions under private rights for domestic and stock use (under section 8 of the *Water Act 1989*), which do not require a licence. The volume associated with these rights is relatively small.
- **Transfers to other basins:** this item represents the transfer of water to another basin where it is either used or contributes to the in-stream flows in the other basin. The corresponding transaction is reported as inflows in the receiving basin.
- **Environmental water diversions to wetlands:** environmental water is often used to support streamflows within a waterway and this contributes to the volume leaving a basin outlet. In some instances, environmental water is diverted from a waterway to off-stream wetlands. Metered diversions to off-stream wetlands under environmental entitlements are accounted for in this component of the water balance.
- **Small catchment dams:** this item represents the estimated volume of extractions from small catchment dams within a basin. The volume extracted — the volume used in each basin — is calculated by multiplying the estimated capacity of each dam by an extraction factor and reducing this number as necessary if the dam had insufficient inflows to actually supply the volume required. In previous years, all volumes presented for small catchment dams were annual average figures. From this year onwards, the volumes presented are estimated, based on the observed annual climate.
- **Losses:** this item represents catchment inflows that are lost from the waterway via natural processes. Losses represent a volume that is unable to be diverted for use and that does not contribute to the flows at a basin outlet. They include:
    - **evaporation losses from major storages:** this item represents direct evaporation from major on-stream storages. It is estimated, based on evaporation rates and the surface area of the storage
    - **losses from small catchment dams:** this item represents the estimated volume of evaporation losses from small catchment dams within a basin. This volume is determined directly from the water balance calculated for each individual dam

- o **in-stream infiltration to groundwater, flows to floodplain and evaporation** *(also referred to as in-stream losses)*: this item represents the volume of water that is lost from the waterway via natural processes and is not directly measurable. In-stream losses include infiltration to groundwater, overbank spills and evaporation. However, the natural processes giving rise to in-stream losses are difficult to measure directly. Consequently, in-stream losses are typically estimated as a proportion or function of gauged streamflow.
    - In the Murray basin, in-stream losses for the year are considered to be the unaccounted-for item in the water balance and are used as balancing items. In this instance, in-stream losses are determined to be the difference between the known outflows and the total inflows plus the net change in storage volume.
    - In most other basins, in-stream losses for the year are estimated based on loss functions used in water resource models (such as REALM). Where suitable models are available, in-stream losses are derived by applying measured streamflow data for the year into the loss functions included in the model. The basins with suitable models are documented in Table 6-1.
    - There are ten basins that do not have water resource models suitable for calculating in-stream losses for use in the accounts: the East Gippsland, Snowy, Tambo, Latrobe, South Gippsland, Yarra, Corangamite, Otway Coast, Hopkins and Portland Coast basins. In the absence of water resource models, in-stream losses could be calculated using water balances. However, this would require streamflow data at the source and outlet of each major river. Although there are a reasonable number of gauged locations across the basins, their distribution means that deriving comprehensive estimates of in-stream losses is not possible. This does not mean there are no in-stream losses in these basins, rather that they cannot be estimated using currently available models, or as the balancing item in the water balances.

Table 6-1 Models used to derive in-stream losses for 2017–18

Basin(s)	Model(s)
Kiewa	Kiewa River REALM (1)
Ovens	Ovens River REALM
Broken, Goulburn, Campaspe, Loddon	Goulburn Simulation Model (covering the Goulburn, Broken, Campaspe and Loddon systems) Wandella Creek REALM (Loddon system only, downstream of Loddon Weir)
Avoca	Kerang Lakes REALM
Wimmera	Wimmera–Glenelg REALM (also referred to as Wimmera Mallee REALM)
Mitchell	Mitchell River REALM, Mitchell River Streamflow Management Plan REALM
Thomson	Thomson–Macalister REALM
Bunyip	Tarago and Bunyip River REALM
Maribyrnong	Maribyrnong REALM
Werribee	Werribee REALM
Moorabool, Barwon	Barwon–Moorabool REALM
Glenelg	Glenelg River REALM, Wimmera–Glenelg REALM

Note
(1) REALM = REsource ALlocation Model.

Water passed at outlet of basin represents the total volume of flows that leaves the end of the basin. The outlets vary from basin to basin and include:

- **outflows to ocean:** common in southern Victoria, where most rivers flow to the sea
- **outflows to other rivers:** common in northern Victoria, where most rivers flow north and join the Murray River
- **outflows to terminal lakes:** several rivers in western Victoria outflow to lakes that are referred to ‘terminal lakes’ as they are not connected to the ocean or to other rivers
- **outflows to another state:** the outlet of the Murray River is considered to be the boundary with South Australia for accounting purposes. Flows across the boundary into South Australia from Victoria’s share of the Murray River resources are considered to be water passed at the outlet of the basin.

The volume of water passed at basin outlets is estimated by using gauged streamflow data at a point as close to the basin outlet as possible and then extrapolating the gauged data to ungauged basin area.

6.1.7 Compliance against entitlements

Compliance against water entitlements is reported in these accounts in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

One table in this subchapter shows the entitlement volume in the basin; the other shows the volume of available water in 2017–18 and the volume taken.

In accordance with the section 43 of the *Water Act 1989*, bulk entitlements may specify rules and obligations on its holder, including:

- rules about when, where and how much water can be taken
- rules about how the water can be used
- rules about the right to a share of storage capacity and a share of inflows
- obligations to release flows for environmental uses
- obligations to supply primary entitlement holders
- obligations to contribute to the payment of operation and maintenance costs
- obligations to meter water, maintain accounts and report.

Bulk entitlement holders report on compliance each year. Specific instances of noncompliance are reported in these accounts in the key compliance points box in each basin chapter.

6.1.7.1 Entitlement issued

A table in each basin chapter shows the volume of entitlements as at 30 June of each water year.

Bulk entitlements specify a maximum volume of water that may be diverted over a given number of years. The 'Annual entitlement volume' column provides the entitlement volume as at the end of the water year and represents the maximum volume that may be diverted in any one year. Where the entitlement volume is an amount specified over more than one year, the total volume that may be taken over the period of the entitlement is shown in the notes. For example, the Gisborne–Barringo Creek bulk entitlement in the Maribyrnong basin specifies that up to 585 ML can be diverted in any one year, while the maximum volume that can be taken over any five-year period is 1,600 ML (320 ML annual average).

In the large, regulated systems, bulk entitlements are normally specified in one of two ways:

- **source bulk entitlement:** this is an entitlement to harvest water directly from a water source. Source entitlements typically cover multiple storages operated in an integrated way within a river basin. They also include obligations to divert or release water to supply primary entitlement holders (such as customers within irrigation districts, licensed diverters in regulated streams, water corporations that hold delivery bulk entitlements and environmental entitlements held by the VEWH).
- **delivery bulk entitlement:** this is an entitlement to be supplied with water from another water corporation's dam or within a water supply system which is regulated by the works of another water corporation.

The bulk entitlement volume for a source bulk entitlement will include the volumes supplied to delivery entitlement holders and other primary entitlement holders specified in the source bulk entitlement. To account for this, primary entitlements are presented inset as a part of the source bulk entitlement. Appendix D lists all Victoria's bulk entitlements and their entitlement holders.

Entitlements to water also include rights granted to individuals (for example, water shares and take and use licences). These are reported as a group of each entitlement types and show the total volume of licences issued per basin.

6.1.7.2 Water taken

This section presents the available water and the water taken in the basin for 2017–18. The components – opening carryover, allocation issued, net trade in/out, total water available and water taken – are described below.

Opening carryover: this item represents any water carried over from 2016–17 that could be taken in 2017–18.

Allocation issued: this item represents the water allocation made available under the entitlement that was available for use and trade in the 2017–18 water year. Individuals or authorities that hold water entitlements in Victoria are allocated water according to the size of their entitlement and the available resource. For example, in 2017–18, entitlement holders with low-reliability water shares in the Thomson–Macalister system were allocated 20% of their entitlement. That is, for every 100 ML of low-reliability entitlement they owned, they were allocated 20 ML of water they could use or trade.

Water issued and used under take and use licences is also represented as allocation in the allocation account balance tables. This allocation issued represents the volume that was available under licences throughout the water year, and it can be different to the entitlement volume at the end of the water year. Where licences have been cancelled during the year, the allocation volume presented may be greater than the entitlement volume as at the end of the water year. The volumes may also be different as a result of temporary trading between systems. For example, temporary trade of licences can occur between unregulated and groundwater systems in the Ovens basin: this would affect the allocation volume issued to licences in the Ovens basin.

Net trade in/out: this item represents the volume of water that may have been traded in for use within the basin or traded out of the basin.

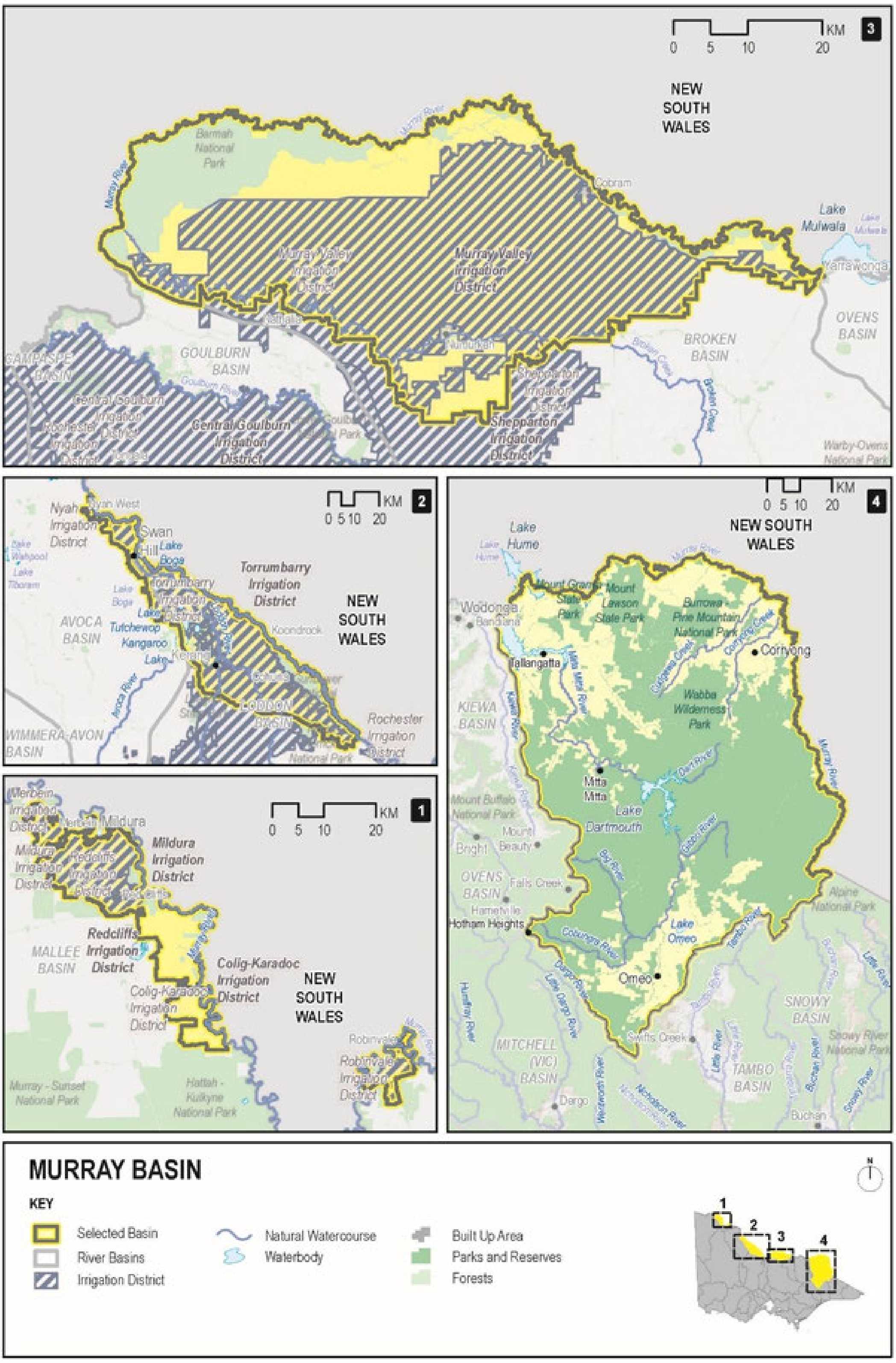
Total water available: This represents the volume of water that was available to be taken in 2017–18. This item is the sum of the first three components: opening carryover, allocation issued and the net of the in/out trade of water.

Water taken: this item represents the volume of water used during the year under the entitlement. Where a source bulk entitlement exists, a total diversion is reported. This represents the volume of water diverted from the waterway to supply the primary entitlements specified in the bulk entitlement.

6.2 Murray basin

The Murray River forms the border with New South Wales. Victoria shares the volume of water held in the major storages with New South Wales under the Murray–Darling Basin Agreement. For the purposes of this report, the Murray basin includes the Upper Murray basin and areas in Victoria supplied from the Murray River downstream of Lake Hume (Figure 6-2).

Figure 6-2 Map of the Murray basin (Victoria)



6.2.1 Management arrangements

Management of water in the Murray basin is undertaken by various parties, the responsibilities of which Table 6-2 shows.

The MDBA operates the Murray River on behalf of the Victorian, New South Wales and South Australian governments in accordance with the water-sharing arrangements set out in the Murray–Darling Basin Agreement. Under the agreement, Victoria shares the waters of the Murray River with New South Wales and South Australia. Under normal conditions, Victoria is entitled to a 50% share of all flows upstream of Doctors Point near Albury–Wodonga (that is, flows to Hume and Dartmouth reservoirs and from the Kiewa River), a 50% share of inflows to the Menindee Lakes storage and all flows entering the Murray from the Ovens, Goulburn, Broken and Campaspe rivers. Victoria is also required under the agreement to supply half of South Australia's monthly entitlement flows from the water available to it.

Goulburn-Murray Water in its role as resource manager is responsible for allocating water from Victoria’s share of the water supply storages in the Murray basin to entitlement holders in the regulated Victorian Murray system.

Table 6-2 Responsibilities for water resources management in the Murray basin (Victoria)

Authority	Management responsibilities
Murray–Darling Basin Authority	• Operates the River Murray system and efficiently delivers water to users on behalf of all Murray River governments; coordinates waterway management along the Murray River and operates the Murray supply system • Oversees water resource management in accordance with the 2012 *Murray–Darling Basin Plan*
Department of Environment, Land, Water and Planning (Victoria)	• Coordinates Victoria’s input to Murray River system operational and resource management decisions
WaterNSW	• Operates Lake Hume, Euston Weir and the Menindee Lakes system on behalf of the MDBA
South Australian Water Corporation	• Operates Lake Victoria and several locks on behalf of the MDBA
Goulburn-Murray Water	• Operates Lake Dartmouth, Yarrawonga Weir (Lake Mulwala), Torrumbarry Weir and Mildura Weir on behalf of the MDBA • Supplies Murray Valley, Torrumbarry, Woorinen, Tresco and Nyah irrigation areas • Manages private diversions on the Victorian side of the Murray upstream of Nyah
Lower Murray Water	• Supplies Red Cliffs, Robinvale, Merbein and the First Mildura irrigation districts • Manages private diversions on the Victorian side of the Murray downstream of Nyah • Supplies towns along the Murray River from Swan Hill to the South Australian border
North East Water	• Supplies towns upstream of Lake Mulwala
Goulburn Valley Water	• Supplies towns in the Murray Valley Irrigation Area
Coliban Water	• Supplies towns in the Torrumbarry Irrigation Area
East Gippsland Water	• Supplies Omeo and Dinner Plain
Grampians Wimmera Mallee Water	• Supplies domestic and stock water to towns and farms in the northern Mallee area
North East Catchment Management Authority	• Responsible for waterway and catchment management in the region bounded by the Murray River in the north, the Victorian Alps in the south, the New South Wales border in the east and the Warby Ranges in the west
Mallee Catchment Management Authority	• Responsible for waterway and catchment management in an area that runs along the Murray River from Nyah to the South Australian border and south to the Wimmera
Goulburn Broken Catchment Management Authority	• Responsible for waterway and catchment management in the region comprising the catchments of the Goulburn and Broken rivers and part of the Murray River valley
North Central Catchment Management Authority	• Responsible for waterway and catchment management in the region bordered by the Murray River to the north, the Great Dividing Range and Wombat State Forest to the south and Mt Camel Range to the east.

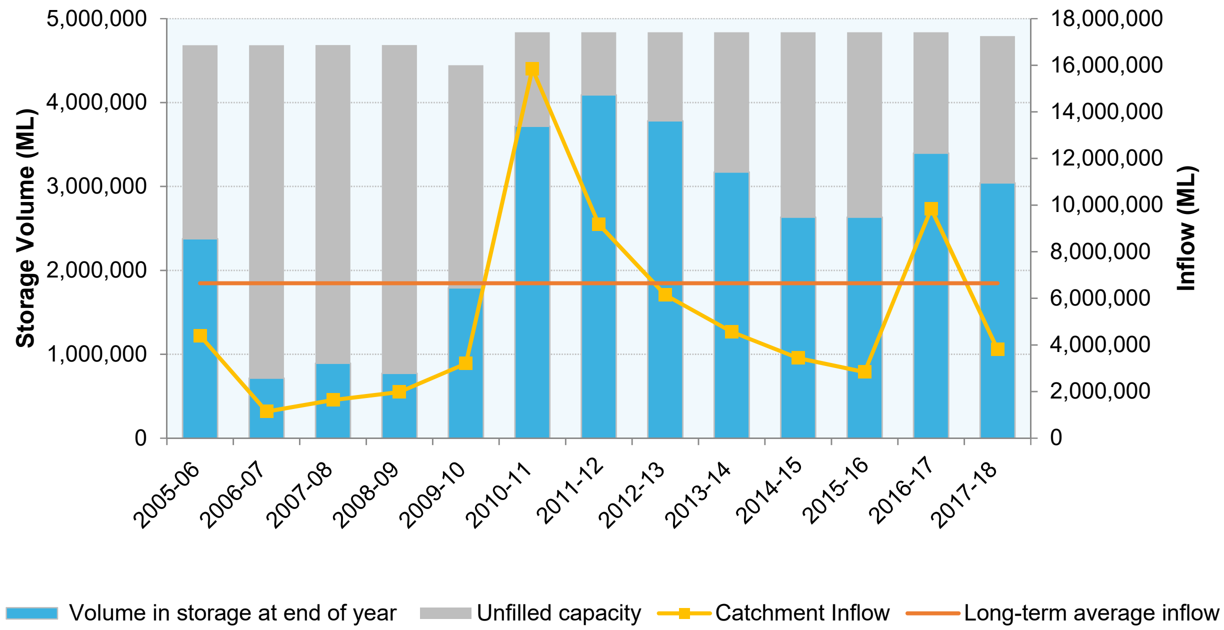
6.2.2 2017–18 Water resource overview

In the Murray basin in 2017–18, rainfall was generally between 80% and 100% of the long-term average in the central areas, with areas near the irrigation districts receiving between 60% and 80%. Above-average rainfall (between 100% and 125%) was received in the eastern Murray section over the Mitta Mitta River and Lake Dartmouth.

Catchment inflows to the Murray basin in 2017–18 were 57% of the long-term average (6,647,925 ML), lower than in 2016–17 when inflows were 148% of the long-term average. The long-term average used in the 2017–18 accounts has been revised from previous accounts and is now an average of post-1975 streamflow: chapter 2-2 explains this.

The volume held in Victoria’s share of the major Murray system storages started at 74% of capacity at the beginning of July and was at 64% of capacity at the end of June 2018. Victoria had access to a share of Menindee Lakes from July 2017 through to mid-December 2017, when storage levels were above the 480,000 ML trigger level specified in the Murray–Darling Basin Agreement. When storages levels are low, the available water is reserved for New South Wales, to supply local needs.

Figure 6-3 Storage volumes and catchment inflows in the Murray basin (Victoria)



Seasonal allocations in the regulated Murray system began the year at 66%, and they reached 100% by October 2017. There was no seasonal allocation for low-reliability water shares in 2017–18.

In 2017–18, two of the Murray basin's unregulated streams had restrictions instated: Black Dog Creek (upper) and Indigo Creek. Bans on licensed diversions in these streams continued from the previous year into July 2017 and August 2017. Restrictions for both these streams were then lifted from September 2017 through to November 2017, then reinstated from December 2017 to June 2018.

There were no urban restrictions applied in the Murray basin during 2017–18, with towns on permanent water-savings rules throughout the year.

In 2017–18, 1,794,917 ML of water was diverted for consumptive purposes (town, domestic and stock, irrigation, commercial supply and diversions to wetlands for environmental purposes). This was more than the 1,465,558 ML diverted in the previous year. Some of the change from the previous year's diversion is related to the reporting of small catchment dam use, which reduced from 12,000 ML last year to only 6,800 ML this year, due to improved hydrological modelling. For more information, see Appendix E.

Water for the environment

Important environmental assets depend on water in the Murray basin.

The Barmah-Millewa Forest, Gunbower Forest, Hattah Lakes and Kerang Wetlands are located along the Murray River and are all internationally significant wetlands listed under the Ramsar Convention. Except for the Kerang Wetlands, these are also The Living Murray Icon sites.

The Lindsay, Wallpolla and Mulcra islands (also The Living Murray Icon sites) also depend water for the environment in the Murray basin. These sites rely on the freshwater inputs from the Murray River to function ecologically.

In 2017–18, the Murray basin (Victoria) water for the environment comprised:

- *Bulk Entitlement (River Murray – Flora and Fauna) Conversion Order 1999* – Flora and Fauna component, comprising 29,783 ML of high-reliability, 3,894 ML of low-reliability and 40,000 ML of unregulated entitlements held by the VEWH
- *Bulk Entitlement (River Murray – Flora and Fauna) Conversion Order 1999* – Living Murray, comprising 9,589 ML of high-reliability, 101,850 ML of low-reliability and 34,300 ML of unregulated entitlements held by the VEWH on behalf of the MDBA
- *Bulk Entitlement (River Murray – Flora and Fauna) Conversion Order 1999* – Barmah-Millewa Forest Environmental Water Allocation – a significant operational rule embedded in consumptive entitlements, comprising 50,000 ML of high-reliability and 25,000 ML of low-reliability entitlements held by the VEWH
- *Bulk Entitlement (River Murray – Flora and Fauna) Conversion Order 1999* – River Murray Increased Flows – comprising Victoria's share of water recovered under the Snowy Water Initiative released from the Snowy Scheme to the River Murray, held by the VEWH
- *Environmental Entitlement (River Murray – NVIRP Stage 1) 2012*, comprising 26,230 ML held by the VEWH, which includes mitigation water allocated for the purposes of watering specific environmental sites that have been identified through the Goulburn-Murray Water Connections Project environmental approvals processes

- Bulk Entitlement (River Murray – Snowy Environmental Reserve) Conversion Order 2004, comprising 29,794 ML of high-reliability entitlements, held by the VEWH
- 351,054 ML of high-reliability water shares and 31,913 ML low-reliability water shares held for the environment
- water set aside for the environment through the operation of passing flows released by the MDBA as a condition of the Murray–Darling Basin Agreement
- water set aside for the environment through flow-sharing arrangements set out in North East Water's and East Gippsland Water's bulk entitlements from unregulated rivers.

In addition, other water in the basin not allocated for consumptive use can provide environmental as well as social, recreational and cultural benefits.

A total of 374,960 ML of environmental water was used in the Murray basin in 2017–18: 149,269 ML of this was diverted off-stream, while the remaining 225,691 ML was delivered in-stream.

6.2.3 Water balance

The total volumes of water available and supplied from water resources in the Murray basin in 2017–18 are shown in Table 6-3.

Table 6-3 Water balance – Murray basin

Water account component	Notes	2017–18 (ML)	2016–17 (ML)
Major on-stream storage			
Volume in storage at start of year	1	3,420,200	1,839,700
Volume in storage at end of year	1	2,921,100	3,396,460
Change in storage		**(499,100)**	**1,556,760**
Inflows			
Catchment inflow	2	3,807,603	9,837,093
Rainfall on major storages	1	112,000	136,400
Net trade from New South Wales	3	0	46,455
Spills from New South Wales	3	2,700	4,500
Return flow from irrigation		306,439	292,329
Treated wastewater discharged back to river	4	3,711	4,248
Total inflows		**4,232,452**	**10,321,025**
Outflows			
Diversions			
Urban diversions		39,949	37,685
Irrigation district diversions		1,119,267	935,548
Licensed diversions from regulated streams		478,343	407,189
Licensed diversions from unregulated streams		1,290	3,483
Environmental water diversions		149,269	69,653
Small catchment dams		6,264	12,000
Total diversions		***1,794,381***	***1,465,558***
Losses			
Evaporation losses from major storages	1	319,800	429,357
Evaporation from small catchment dams	5	3,674	0
In-stream infiltration to groundwater, flows to floodplain and evaporation	6	131,372	1,382,810
Total losses		***454,846***	***1,812,167***
Water passed to other systems			
Murray River flows to South Australia from Victoria's allocation		2,032,170	5,486,540
Ceded to New South Wales	3	89,300	102,760
Spills to New South Wales	3	245,400	5,370
Net trade to New South Wales	3	115,455	0
Total water passed at outlet of basin		***2,482,325***	***5,486,540***
Total outflows		**4,731,552**	**8,764,265**

Notes to the water balance

This water balance for the Murray river system includes only the Victorian portion of the Murray resource.

The volumes presented in the water balance may not be consistent with the MDBA's cap compliance reporting, due to different accounting methods.

Some volumes presented in the 2016–17 comparison column have changed from the *Victorian Water Accounts 2016–17*. Details of these changes are noted in the notes below.

1. Storages

Major on-stream storages in the Murray basin are included in the water balance. A breakdown of the volumes presented is in Table 6-4. Volumes in off-stream storages are presented for additional information about the resource condition.

The volume in storage at the start of the water year has been revised from the amount reported as a closing balance in 2016–17. Adjusted volumes are based on new information available from data providers.

Table 6-4 Storage volumes in the Murray basin

Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Lake Dartmouth (Vic. share)	1,928,116	1,684,000	33,700	35,900	246,200	1,928,000
Lake Hume (Vic. share)	1,502,579	1,243,100	56,200	107,500	(382,300)	809,500
Lake Victoria (Vic. share)	338,500	227,700	12,200	86,200	29,900	183,600
Menindee Lakes (Vic. share)	865,500	265,400	9,900	90,200	(185,100)	0
Total on-stream storages	**4,634,695**	**3,420,200**	**112,000**	**319,800**	**(291,300)**	**2,921,100**
Off-stream storages						
Kangaroo Lake	39,200	31,280	2,626	11,070	8,444	31,280
Kow Swamp	51,710	35,769	6,769	29,246	23,193	36,485
Lake Boga	37,000	20,470	2,516	10,608	15,708	28,086
Lake Charm	22,000	30,298	1,411	5,926	(5,560)	20,223
Lake Cullulleraine	5,270	4,438	400	4,120	3,736	4,454
Total off-stream storages	**155,180**	**122,255**	**13,722**	**60,970**	**45,521**	**120,528**
Total storage volumes 2017–18	**4,789,875**	**3,542,455**	**125,722**	**380,770**	**(245,779)**	**3,041,628**
Total storage volumes 2016–17	4,836,375	1,952,676	159,291	484,129	1,890,876	3,518,715

2. Catchment inflow

Inflows are calculated based on estimates of inflows to major on-stream storages plus inflows from tributaries.

Catchment inflow is defined as:

- Victoria’s share of inflows to Lake Dartmouth, Lake Hume, Lake Victoria and the Menindee Lakes system
- Victoria’s share of inflows from the Kiewa River
- flows from the Ovens, Goulburn, Campaspe and Loddon rivers and from Broken Creek into the Murray River.

3. Movements between Victoria and New South Wales

In accordance with the Murray–Darling Basin Agreement and state trading rules, water can move between Victoria and New South Wales shares of the River Murray system through ceding, internal spills and trade.

In 2017–18 Victoria ceded a total of 89,300 ML to New South Wales. This comprised 66,800 ML in Hume Dam and 22,500 ML in Menindee Lakes.

Internal spills between Victoria and New South Wales occur when only one state’s share of a storage is full and inflows are internally spilled, becoming resources for the state which has capacity to store them. In 2017–18, there was a net internal spill from Victoria to New South Wales of 242,700 ML. This comprised:

- 87,900 ML of internal spill from Victoria to New South Wales in Hume Dam
- 157,500 ML of internal spill from Victoria to New South Wales in Lake Victoria
- 2,700 ML of internal spill from New South Wales to Victoria in Lake Victoria.

In 2017–18, there was net trade from Victoria to New South Wales of 115,455 ML. This included trade between environmental water holders, as well as non-environment trade.

4. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-5 lists the wastewater treatment plants in the Murray basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-5 Volume and use of recycled water in the Murray basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Bellbridge	45	45	100%	0	45	0	0	0	0
Bundalong	0	0	0%	0	0	0	0	0	0
Cobram	280	280	100%	0	280	0	0	0	0
Cohuna	0	0	0%	0	0	0	0	0	0
Corryong	113	113	100%	0	113	0	0	0	0
Dartmouth	11	0	0%	0	0	0	0	11	0
Gunbower / Leitchville	0	0	0%	0	0	0	0	0	0
Koondrook	99	0	0%	0	0	0	0	0	99
Koorlong	2,280	2,176	95%	0	2,176	0	0	0	104
Lake Boga	48	0	0%	0	0	0	0	0	48
Merbein	139	102	74%	0	102	0	0	0	37
Mildura	1,300	676	52%	0	676	0	0	0	624
Murrabit	6	0	0%	0	0	0	0	0	6
Nathalia	106	106	100%	0	106	0	0	0	0
Numurkah	136	136	100%	0	136	0	0	0	0
Nyah / Nyah West	84	0	0%	0	0	0	0	0	84
Omeo	22	22	100%	0	22	0	0	0	0
Robinvale	246	205	83%	0	205	0	0	0	41
Strathmerton	0	0	0%	0	0	0	0	0	0
Swan Hill	1,179	0	0%	0	0	0	0	0	1,179
Tallangatta	106	106	100%	0	106	0	0	0	0
Walwa	4	4	100%	0	4	0	0	0	0
Wodonga	3,959	260	4%	155	0	0	105	3,699	0
Yarrawonga	511	511	100%	0	511	0	0	0	0
Total 2017–18	**10,674**	**4,742**	**44%**	**155**	**4,482**	**0**	**105**	**3,710**	**2,222**
Total 2016–17 (1)	11,050	4,081	36%	137	3,843	0	101	4,248	2,722

5. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-6 provides information about small catchment dams in the basin.

New hydrological modelling has provided a more-accurate measure of usage and harvested volumes for the 2017–18 reporting period. Therefore, the volumes for small catchment dams in 2016–17 are not directly comparable with the volumes reported for 2017–18. Each year presents the best estimate of the water harvested, used and lost, based on the best information that was available at the time. For more information, see Appendix E and chapter 6.1.2.

Table 6-6 Estimated small catchment dam information for the Murray basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	12,018	4,101	3,138	7,238
Registered/licensed commercial and irrigation	4,247	2,163	536	2,699
Total 2017–18	**16,265**	**6,264**	**3,674**	**9,938**
Total 2016–17	16,666	12,000	0	12,000

6. In-stream losses

In-stream losses are the balancing item in this water balance. It is the difference between of the total inflows, the known outflows and the net change in storage volume. This volume may not be consistent with the MDBA's accounts due to different accounting methods.

6.2.4 Compliance against entitlements

Compliance against water entitlements is reported in these accounts in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals

- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Murray – Key compliance points

- ✓ **There was no net increase to the total entitlement volume from the previous year.**
- ✓ **The total volume diverted (1,709,549 ML) was within the volume available for the year (2,258,868 ML).**
- ✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
- ✓ **Individual bulk entitlement holders complied with all provisions in their entitlements apart from:**
  - ✗ **under the *Bulk Entitlement (River Murray – Goulburn-Murray Water) Conversion Order 1999*, losses recorded for Torrumbarry (including Tresco) were within the allowance, but the loss recorded for Tresco exceeded the Schedule 5 fixed loss allowance by 34 ML. Goulburn-Murray Water is monitoring loss performance against this allowance**
  - ✗ **under the *Bulk Entitlement (River Murray – Grampians Wimmera Mallee Water) Order 1999*, no approved metering plan has been implemented for that order.**

Entitlements in the Murray basin provide the basis for how water is shared in the basin. Rights to water in the Murray basin are shown in Table 6-7.

Most entitlements to water in the regulated Murray provide the right to carry over unused allocation to the next season. In the Murray basin, these entitlement holders can carry over unused water up to 100% of their entitlement volume. Water held above entitlement volume is also subject to a risk of spill from major storages: 93,733 ML was written off due to spill events in 2017–18.

Diversions under bulk entitlements are assessed against the Murray–Darling basin annual cap target for the Murray–Kiewa–Ovens valley. Since 2012, cap compliance has been reported to the MDBA through the *Transition Period Water Take Report* (refer to the MDBA's website > Publications). Before this, details of this assessment were published annually in the MDBA's *Water Audit Monitoring Report.*

Table 6-7 Entitlement volumes in the Murray basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (River Murray – Goulburn-Murray Water) Conversion Order 1999	
High-reliability water shares	940,807
Low-reliability water shares	303,038
High-reliability supply by agreements	1,084
Low-reliability supply by agreements	456
Bulk Entitlement (River Murray – South East Water) Order 2012 (1)	n/a
Bulk Entitlement (River Murray – City West Water) Order 2012 (1)	n/a
Bulk Entitlement (River Murray – Yarra Valley Water) Order 2012 (1)	n/a
Environmental Entitlement (River Murray – NVIRP stage 1) 2012 (2)	n/a
Loss allowance – irrigation district (3)	231,443
Loss allowance – Victorian Mid-Murray Storages (4)	n/a
Subtotal: Bulk Entitlement (River Murray – Goulburn-Murray Water) Conversion Order 1999	**1,476,829**
Bulk Entitlement (River Murray – Lower Murray Urban and Rural Water – Irrigation) Conversion Order 1999	
High-reliability water shares	303,990
Low-reliability water shares	8,568
Millewa waterworks district	700
Yelta Wargan waterworks district	14
Provision for statutory domestic and stock rights	532
Loss allowance (5)	15,981
Subtotal: Bulk Entitlement (River Murray – Lower Murray Urban and Rural Water – Irrigation) Conversion Order 1999	**329,785**
Bulk Entitlement (River Murray – Lower Murray Urban and Rural Water – Urban) Conversion Order 1999	30,971
Bulk Entitlement (River Murray – Grampians Wimmera Mallee Water) Conversion Order 1999	3,486
Bulk Entitlement (River Murray – North East Water) Conversion Order 1999	13,236
Bulk Entitlement (River Murray – Goulburn Valley Water) Conversion Order 1999	5,593
Bulk Entitlement (River Murray – Coliban Water) Conversion Order 1999	6,285
Bulk Entitlement (Corryong) Conversion Order 2000	680
Bulk Entitlement (Cudgewa) Conversion Order 2000	29
Bulk Entitlement (Dartmouth) Conversion Order 2000	60

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Omeo) Conversion Order 2008	77
Bulk Entitlement (Walwa) Conversion Order 2000	61
Bulk Entitlement (River Murray – Flora and Fauna) Conversion Order 1999	
High-reliability entitlement	39,371
Low-reliability entitlement	105,744
Unregulated entitlement	74,300
Barmah-Millewa Forest Environmental Water Allocation (BMFEWA) (6)	
Barmah-Millewa Forest Environmental Water Allocation – high reliability	50,000
Barmah-Millewa Forest Environmental Water Allocation – low reliability	25,000
River Murray Increased Flows (RMIF) (7)	n/a
Subtotal: Bulk Entitlement (River Murray – Flora and Fauna) Conversion Order 1999	**294,415**
Bulk Entitlement (River Murray – Snowy Environmental Reserve) Conversion Order 2004	29,794
Take and use licences – unregulated surface water	16,228
Total (30 June 2018)	**2,207,528**
Total (30 June 2017) (8)	**2,207,555**

Notes

(1) Together, these entitlements provide City West Water, South East Water and Yarra Valley Water with a total annual allocation of water equal to one-third of the phase 3 Murray water savings achieved in the previous year under Goulburn-Murray Water Connections Project stage 1.

(2) This entitlement provides the VEWH with a total annual allocation of water equal to one-third of the phase 3 Murray water savings achieved in the previous year under Goulburn-Murray Water Connections Project stage 1.

(3) These loss allowances represent the total loss allowances as outlined in the bulk entitlement. The actual loss allowed may vary year to year based on the rules in the bulk entitlement, actual delivery volumes, carryover or headroom allowance.

(4) The allowance for loss in the Victorian Mid-Murray Storages includes a portion of fixed distribution loss and is adjusted for the net evaporation from the storages (Kow Swamp, Kangaroo Lake, Lake Charm and Lake Boga).

(5) The loss allowance volume includes 4,800 ML loss allowance for the Millewa waterworks district.

(6) The Barmah-Millewa Forest Environmental Water Allocation includes 50 GL of high-reliability entitlement and 25 GL of low-reliability entitlement, and is matched by equivalent entitlements in New South Wales. Conditions of the entitlement provide for the allocation to be borrowed to support Victorian Murray allocations and specifies certain conditions when the allocation must be released.

(7) The River Murray Increased flows entitlement reflects the water available recovered under the Snowy Water Initiative for the health of the Murray River. It provides for up to 70 GL of water being made available in the Snowy Scheme each year, however the volume available in the Murray in a given year depends on the volume of this water released from the Snowy Scheme to the Murray River.

(8) The total volume reported for 30 June 2017 differs from the volume reported in the 2016–17 accounts to reflect the volume that would have been reported if the RMIF portion of the River Murray – Flora and Fauna entitlement was reported as n/a last year.

n/a Not applicable.

Table 6-8 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-8 Available water and take for the Murray basin

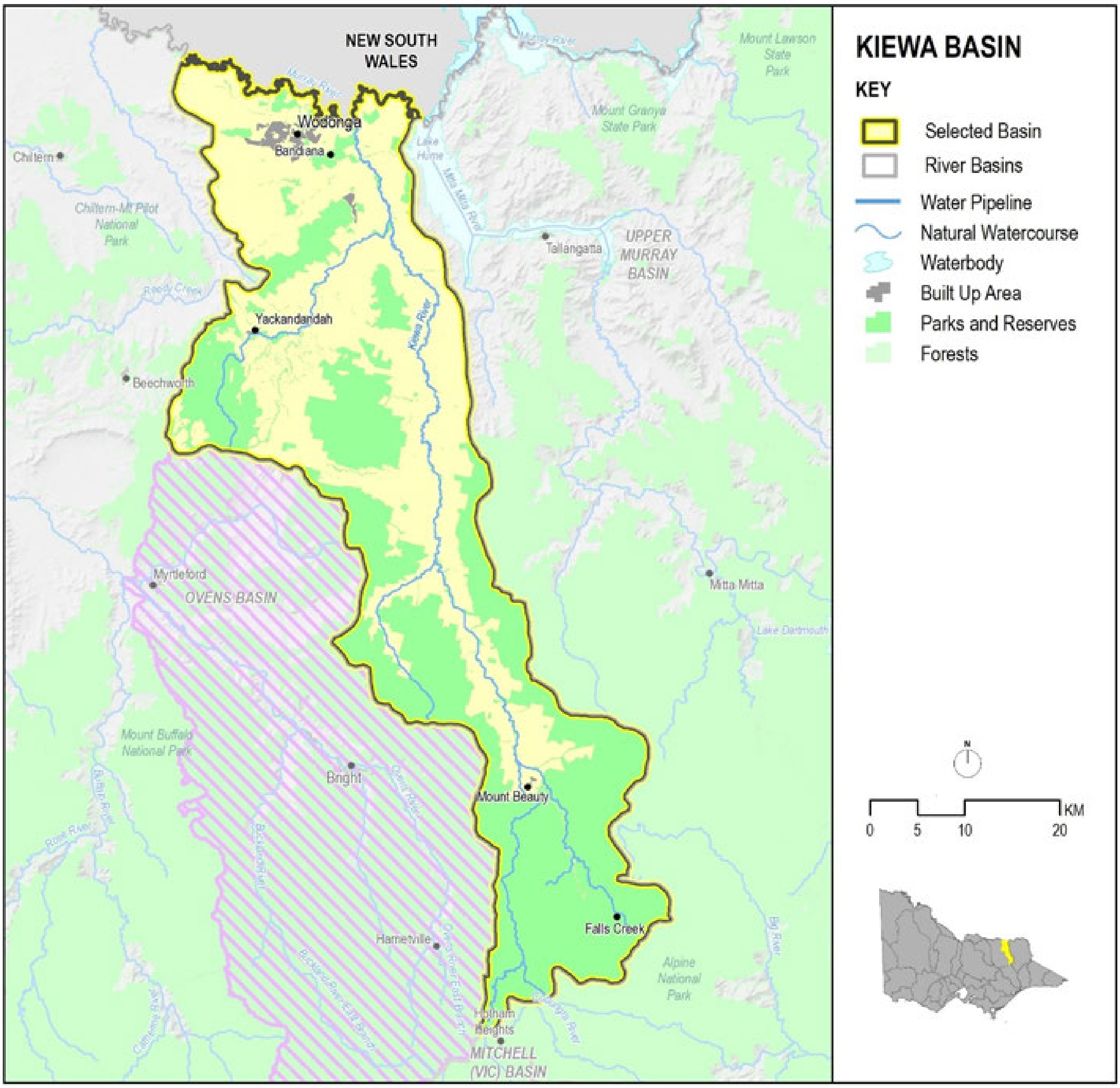
Water entitlement	Available water					Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Spillable write-off	Total available water	
River Murray – Goulburn-Murray Water						
Water shares	415,024	909,355	(380,171)	(72,205)	**872,003**	**590,058**
Supply by agreements	606	1,134	49	(150)	**1,638**	**1,101**
River Murray – Melbourne retailers (1)	17,137	14,120	(17,514)	0	**13,743**	**0**
River Murray – NVIRP stage 1 (2)	22,528	14,744	(3,243)	0	**34,030**	**7,848**
Loss allowance – irrigation districts						**117,691**
Operating provisions (whole of system) (3)						**31,851**
Net diversion: River Murray – Goulburn-Murray Water (4)						**748,548**
River Murray – Lower Murray Urban and Rural Water – Irrigation						
Water shares	64,018	335,391	203,127	(17,803)	**584,733**	**533,065**
Millewa waterworks district	(86)	700	470	0	**1,084**	**1,074**
Yelta Wargan waterworks district	0	14	0	0	**14**	**2**
Loss allowance – irrigation districts (5)						**12,116**
Diversion: River Murray – Lower Murray Water (6)						**546,257**
River Murray – Lower Murray Water (Urban)	(68)	30,971	(9,197)	0	**21,706**	**21,297**
River Murray – Wimmera Mallee Water	1,244	3,486	1,130	(492)	**5,367**	**4,216**
River Murray – North East Water (7)	589	15,441	(5,584)	(217)	**15,895**	**9,724**
River Murray – Goulburn Valley Water	116	5,593	0	(43)	**5,666**	**4,182**
River Murray – Coliban Water	784	6,285	(442)	(305)	**6,322**	**4,375**
Corryong	-	680	0	-	**680**	**279**
Cudgewa	-	29	0	-	**29**	**0**
Dartmouth	-	60	0	-	**60**	**22**
Omeo	-	77	0	-	**77**	**56**
Walwa	-	61	0	-	**61**	**14**
River Murray – Flora and Fauna						
High- and low-reliability components (8)	11,023	699,656	(350,461)	(2,517)	**357,700**	**349,392**
Unregulated entitlement	-	0	0	-	**0**	**0**
BMFEWA	112,900	75,000	0	-	**187,900**	**0**
RMIF (9)	0	157,000	(16,500)	-	**140,500**	**17,720**
Subtotal: River Murray – Flora and Fauna (10)						**367,112**
River Murray – Snowy Environmental Reserve (11)	-	29,794	(29,794)	-	**0**	**0**
Take and use licences – unregulated surface water	-	16,326	0	-	**16,326**	**3,467**
Total 2017–18	**645,813**	**2,314,918**	**(608,129)**	**(93,733)**	**2,259,868**	**1,709,549**
Total 2016–17	459,914	1,747,969	(53,556)	(276,854)	1,877,473	1,522,196

Notes
(1) Melbourne retail water corporations' entitlements are reported in one account, as they each own equal shares of the available allocation.
(2) Water use reported under this entitlement represents water diverted from the waterway.
(3) Operating provisions include primarily the change in storage and other effects of the Victorian Mid-Murray Storages (Kow Swamp, Lake Charm, Kangaroo Lake and Lake Boga).
(4) The water use reported in this line item represents the net diversion to supply primary entitlements and fulfil other operating requirements under the Goulburn-Murray Water Murray system source bulk entitlement (net of return flow from irrigation).
(5) The loss recorded under the Lower Murray Water irrigation bulk entitlement includes loss in the Millewa waterworks district.
(6) The water use reported in this line item represents the bulk diversion to supply primary entitlements and fulfil other operating requirements under the Lower Murray Urban and Rural Water – Irrigation Murray system source bulk entitlements.
(7) Allocation includes return flows of 2,206 ML credited to North East Water from Wodonga recycled water treatment.
(8) Allocation includes return flows of 660,284 ML credited to the VEWH from deliveries of environmental water.
(9) 157,000 ML of RMIF allocation was made available in 2017–18, following the release of above-target water from the Snowy Scheme. 16,500 ML of this allocation was traded to South Australia for immediate delivery, to provide environmental outcomes in the River Murray downstream of the South Australian border.
(10) Water use reported under this entitlement represents both in-stream use and actual diversions from the waterway. Of the 349,392 ML reported, 141,421 ML represents diversions from the waterway.
(11) Water allocated to this entitlement between 1 July 2017 and 31 January 2018 was traded to the Snowy inter-valley transfer account to offset reductions in releases from the Snowy Scheme as part of the Snowy Water Initiative and to allow equivalent volumes to be released from the Scheme as Snowy River Increased Flows and RMIF to support the environmental health of those rivers.

6.3 Kiewa basin

The Kiewa basin (Figure 6-4) is located in northern Victoria and drains to the Murray River. The Kiewa River is about 100 km long, extending from the Bogong High Plains and draining northward to the Murray River.

Figure 6-4 Map of the Kiewa basin



6.3.1 Management arrangements

Management of water in the Kiewa basin is undertaken by various parties, the responsibilities of which Table 6-9 shows.

Outflows from the Kiewa basin are shared on a 50-50 basis between Victoria and New South Wales within the Murray system.

Table 6-9 Responsibilities for water resources management in the Kiewa basin

Authority	Management responsibilities
Goulburn-Murray Water	• Manages private diversions
North East Water	• Supplies towns across the basin including Wodonga and Mount Beauty
AGL Hydro	• Operates reservoirs in the Kiewa basin for hydropower generation
North East Catchment Management Authority	• Responsible for waterway and catchment management in the region bounded by the Murray River in the north, the Victorian Alps in the south, the New South Wales border in the east and the Warby Ranges in the west

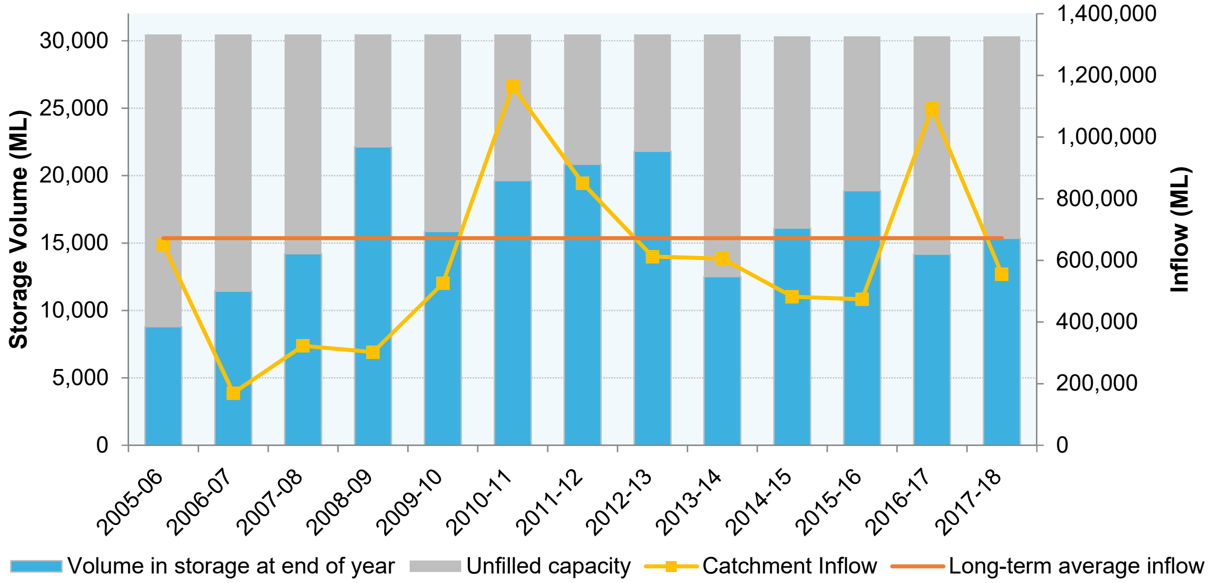
6.3.2 2017–18 Water resource overview

In 2017–18, the Kiewa basin received between 80% and 100% of the long-term average rainfall in the northern half of the basin and between 100% and 125% in the southern half of the basin.

The long-term average used in the 2017–18 accounts has been revised from previous accounts and is now an average of post-1975 streamflow, as chapter 2.2 explains. Catchment inflows were 83% of the revised long-term average annual volume of 670,285 ML: less than the inflows recorded in 2016–17, which were 163% of the revised long-term average. The volume of water flowing out of the Kiewa River into the Murray basin represented 92% of the Kiewa basin's total inflows.

The major water storages in the Kiewa basin finished the year at 51% of capacity, compared to 47% of capacity at the start of the year.

Figure 6-5 Storage volumes and catchment inflows in the Kiewa basin



In July 2017, there were bans on licensed diversions on two streams in the Kiewa basin; a ban on Bay Creek was lifted in August and a ban on Bight Creek was lifted in September. Bans were again placed on Bight Creek in late November and Middle Creek in December 2017. Between January and March, another ten streams were added to this list, bringing the peak total to 13, six more than the previous year. By the end of June 2018, licensed diversions remained restricted on all 13 of these streams.

No urban water-use restrictions were applied in the Kiewa basin in 2017–18, with all towns on permanent water-saving rules throughout the year.

In 2017–18, 8,292 ML of water was diverted for consumptive purposes (town, domestic and stock, irrigation and commercial supply). This was less than the 12,000 ML diverted in the previous year. Some of the change from the previous year's diversion is related to the reporting of small catchment dam use, which reduced from 7,440 ML last year to only 3,225 ML this year, due to improved hydrological modelling. For more information, see Appendix E.

Water for the environment

Important environmental assets (such as threatened remnant vegetation and the Murray cod) exist in the reaches of the West Kiewa River and lower Kiewa River and depend on water in the Kiewa basin. The nationally significant Alpine wetlands, known as the Alpine sphagnum bogs and associated fens, also rely on this water. Water from the Kiewa basin also flows into the Murray River, helping to protect environmental assets in the Murray basin.

In 2017–18, water for the environment in the Kiewa basin comprised:

- water set aside for the environment through flow-sharing arrangements and the operation of passing flows released as a condition of bulk entitlements held by North East Water and AGL Hydro Ltd
- water set aside for the environment through the operation of passing flow conditions on licensed diversions
- all other water in the basin not allocated for consumptive use: this water also provides social, recreational and cultural benefits.

6.3.3 Water balance

The total volumes of water available and supplied from water resources in the Kiewa basin in 2017–18 are shown in Table 6-10.

Table 6-10 Water balance – Kiewa

Water account component	Note	2017–18 (ML)	2016–17 (ML)
Major on-stream storage			
Volume in storage at start of year	1	13,704	18,473
Volume in storage at end of year	1	14,864	13,704
Change in storage		**1,160**	**(4,769)**
Inflows			
Catchment inflow	2	555,981	1,092,663
Rainfall on major storages	1	n/a	3,888
Treated wastewater discharged back to river	3	351	388
Total inflows		**556,333**	**1,096,939**
Outflows			
Diversions			
Urban diversions		432	489
Licensed diversions from unregulated streams		4,635	4,071
Transfer to Ovens basin	4	577	0
Small catchment dams	5	3,225	7,440
Total diversions		***8,869***	***12,000***
Losses			
Evaporation losses from major storages	1	n/a	2,421
Evaporation from small catchment dams	5	1,694	1,963
In-stream infiltration to groundwater, flows to floodplain and evaporation	6	32,866	54,936
Total losses		***34,560***	***59,321***
Water passed at outlet of basin			
Kiewa basin outflow to Murray River – Victoria share		255,872	515,194
Kiewa basin outflow to Murray River – New South Wales share		255,872	515,194
Total water passed at outlet of basin		***511,744***	***1,030,388***
Total outflows		**555,173**	**1,101,708**

Note
n/a Not applicable.

Notes to the water balance

1. Storages

Major on-stream storages in the Kiewa basin are included in the water balance. A breakdown of the volumes presented is shown in Table 6-11. Volumes in off-stream storages are presented for additional information about the resource condition.

In previous years, an assessment of rainfall and evaporation for Lake Guy and Rocky Valley was made, based on information at nearby sites. This information is no longer available, so consequently no estimation of these factors has been made in 2017–18.

Table 6-11 Storage volumes in the Kiewa basin

Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Lake Guy	1,416	570	n/a	n/a	(114)	457
Rocky Valley Lake	28,294	13,134	n/a	n/a	1,273	14,407
Total on-stream storages	**29,710**	**13,704**	**n/a**	**n/a**	**1,160**	**14,864**
Off-stream storages						
Clover Pondage	255	117	n/a	n/a	18	134
Pretty Valley basin	355	355	n/a	n/a	0	355
Total off-stream storages	**610**	**472**	**n/a**	**n/a**	**18**	**489**
Total storage volumes 2017–18	**30,320**	**14,175**	**n/a**	**n/a**	**1,178**	**15,353**
Total storage volumes 2016–17	30,320	18,888	3,888	2,421	(6,179)	14,175

Note

n/a Not applicable.

2. Catchment inflow

Catchment inflow is the balancing item in this water balance. It is the difference between the total outflows, the known inflows and the net change in storage volume.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-12 lists the wastewater treatment plants in the Kiewa basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

The treated wastewater volume of 351 ML returned to the river includes the amount discharged to the environment from wastewater treatment plants as well as an amount of 141 ML returned from the Falls Creek Alpine Resort to Rocky Valley Creek.

Table 6-12 Volume and use of recycled water in the Kiewa basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Baranduda	0	0	0%	0	0	0	0	0	0
Dinner Plain	58	58	100%	0	58	0	0	0	0
Mount Beauty	214	5	2%	5	0	0	0	210	0
Yackandandah	77	77	100%	0	77	0	0	0	0
Total 2017–18	**349**	**140**	**40%**	**5**	**135**	**0**	**0**	**210**	**0**
Total 2016–17	405	146	36%	5	141	0	0	260	0

4. Transfer to Ovens basin

The 577 ML transfer represents water that is transferred to the Ovens basin to be supplied to urban customers in Beechworth.

5. Small catchment dams

Water harvested, used and lost by small catchment dams (farm dams) is included in the water balance. Table 6-13 provides information about small catchment dams in the basin.

New hydrological modelling has provided a more-accurate measure of usage and harvested volumes for the 2017–18 reporting period. Therefore, the volumes for small catchment dams in 2016–17 are not directly comparable with the volumes reported for 2017–18. Each year presents the best estimate of the water harvested, used and lost, based on the best information that was available at the time. For more information, see Appendix E and chapter 6.1.2.

Table 6-13 Estimated small catchment dam information for the Kiewa basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	6,406	1,856	1,333	3,190
Registered/licensed commercial and irrigation	4,519	1,368	361	1,729
Total 2017–18	**10,925**	**3,225**	**1,694**	**4,919**
Total 2016–17	11,754	7,440	1,963	9,403

6. In-stream losses

The method used to estimate in-stream loss in the Kiewa basin in the 2017–18 accounts has been revised from previous accounts, see chapter 6.1.2 for discussion. This has reduced the in-stream loss estimate by 17% for 2017–18: the previous estimate would have resulted in an in-stream loss of 39,775 ML.

6.3.4 Compliance against entitlements

Compliance against water entitlements is reported in these accounts in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- bulk entitlement provisions: holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Kiewa – Key compliance points	
✓	**There was no net increase to the total entitlement volume from the previous year: the apparent increase shown in Table 6-14 is due to the total volume of entitlements for Kiewa now including the Beechworth bulk entitlement (see note to Table 6-14).**
✓	**The total volume diverted (5,644 ML) was within the volume available for the year (16,615 ML).**
✓	**No individual bulk entitlement holder took more than the annual volume made available to them.**
✓	**Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the Kiewa basin provide the basis for how water is shared in the basin. Rights to water in the Kiewa basin are outlined in Table 6-14.

Diversions under bulk entitlements are assessed against the Murray–Darling basin annual cap target for the Murray–Kiewa–Ovens valley. Since 2012, cap compliance has been reported to the MDBA through the *Transition Period Water Take Report* (refer to the MDBA's website > Publications). Before this, details of this assessment were published annually in the MDBA's *Water Audit Monitoring Report.* Carryover provisions are not available for entitlement holders in the Kiewa basin.

Table 6-14 Entitlement volumes in the Kiewa basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Beechworth) Conversion Order 2001 (1)	1,100
Bulk Entitlement (Kiewa – Hydro) Conversion Order 1997 (2)	n/a
Bulk Entitlement (Kiewa – Tangambalanga) Conversion Order 2000	179
Bulk Entitlement (Mount Beauty – Tawonga) Conversion Order 1997	718
Bulk Entitlement (Yackandandah) Conversion Order 2001	209
Take and use licences – unregulated surface water	15,507
Total (30 June 2018)	**17,714**
Total (30 June 2017)	**16,616**

Notes

(1) The Beechworth bulk entitlement was previously reported in the Ovens basin. This entitlement can source water from both the Kiewa and the Ovens basins, however the majority of the water is sourced from the Kiewa. The town of Beechworth is physically in the Ovens basin, so any water sourced from the Ovens under this entitlement is transferred to the Ovens basin for use.

(2) This bulk entitlement held by AGL Hydro Ltd is for non-consumptive purposes. All water diverted under this entitlement must be returned to the waterway. A specified volume is not applicable.

n/a Not applicable.

Table 6-15 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-15 Available water and take for the Kiewa basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Beechworth	-	1,100	0	**1,100**	**577**
Kiewa – Hydro (1)	-	-	-	-	-
Kiewa – Tangambalanga	-	179	0	**179**	**0**
Mount Beauty – Tawonga	-	718	0	**718**	**253**
Yackandandah	-	209	0	**209**	**179**
Take and use licences – unregulated surface water	-	15,510	(1)	**15,509**	**4,635**
Total 2017–18	**-**	**16,616**	**(1)**	**16,615**	**5,644**
Total 2016–17	-	16,697	0	16,697	5,098

Note

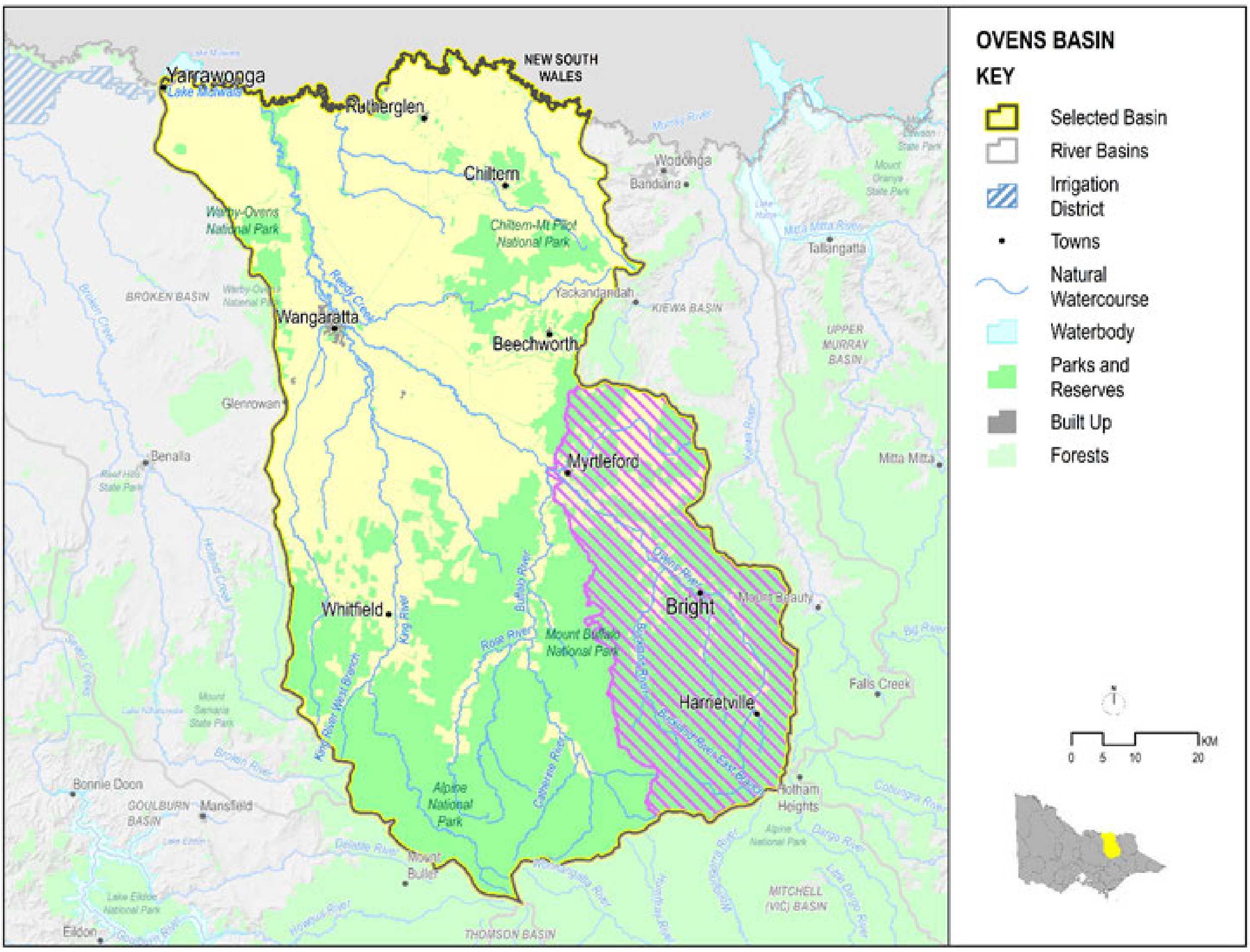
(1) This bulk entitlement held by AGL Hydro Ltd is for non-consumptive purposes. All water diverted under this entitlement must be returned to the waterway, therefore no volumes are reported as diversions for the purposes of this table.

n/a Not applicable.

6.4 Ovens basin

The Ovens basin (Figure 6-6) is located in north-east Victoria. It covers an area that extends from the Murray River in the north to the Great Dividing Range in the south and is bordered by the Broken basin in the west and the Kiewa basin in the east.

Figure 6-6 Map of the Ovens basin



6.4.1 Management arrangements

Management of water in the Ovens basin is undertaken by various parties, the responsibilities of which Table 6-16 shows.

Table 6-16 Responsibilities for water resources management in the Ovens basin

Authority	Management responsibilities
Goulburn-Murray Water	• Supplies primary entitlements in the regulated Ovens and King systems • Manages licensed diversions • Operates Lake Buffalo and Lake William Hovell
North East Water	• Supplies towns including Wangaratta, Bright, Myrtleford, Beechworth and Chiltern
North East Catchment Management Authority	• Responsible for waterway and catchment management in the region bounded by the Murray River in the north, the Victorian Alps in the south, the New South Wales border in the east and the Warby Ranges in the west

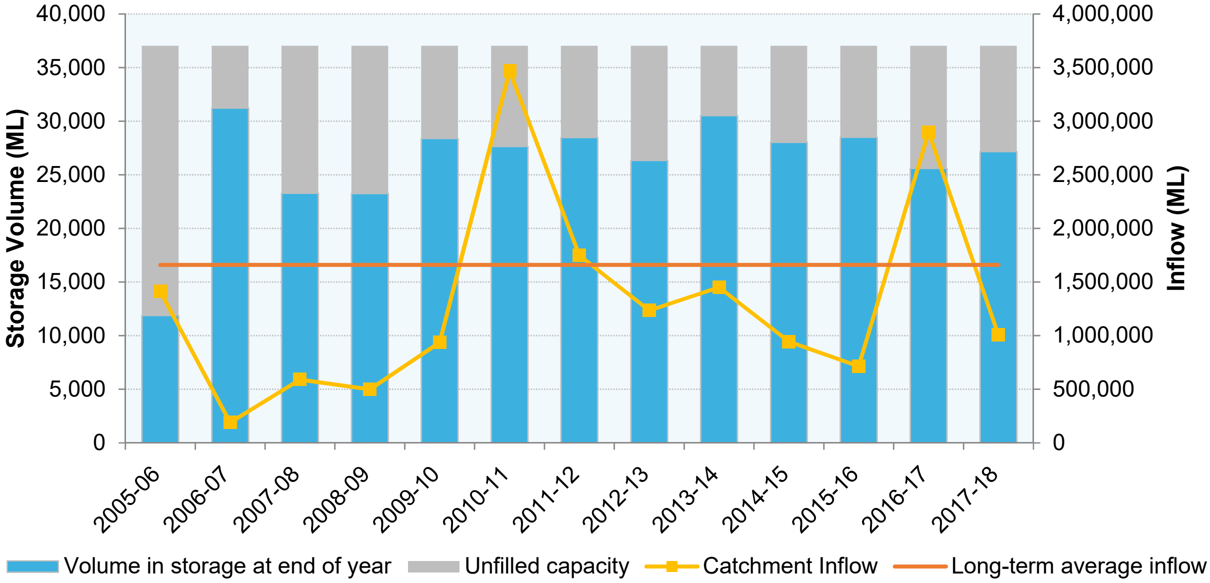
6.4.2 2017–18 Water resource overview

In 2017–18, rainfall across the Ovens basin was between 80% and 100% of the long-term average in most of the basin, except for the south-east corner which received between 100% and 125%.

The long-term average used in the 2017–18 accounts has been revised from previous accounts and is now an average of post-1975 streamflow, as chapter 2.2 explains. Catchment inflows in 2017–18 were 61% of the revised long-term average annual volume of 1,668,252 ML: less than the inflows recorded in 2016–17, which were 175% of the revised long-term average. The volume of water flowing out of the Ovens basin into the Murray River represented 95% of the Ovens basin's total inflows.

The major water storages in the Ovens basin finished the year at 73% of capacity, compared to a lower 69% of capacity at the start of the year.

Figure 6-7 Storage volumes and catchment inflows in the Ovens basin



In July 2017, restrictions on diversions remained for Roberts Creek but were lifted in early August. All unregulated streams were then unrestricted until December 2017, when stage 3 restrictions were placed on Roberts Creek and stage 1 restrictions on Hurdle and Scrubby creeks. Another four streams were placed on restrictions by March 2018, bringing the peak total of streams on restrictions to seven, compared to five in the previous year. These restrictions remained in place until the end of June 2018.

No urban water-use restrictions were applied in the Ovens basin in 2017–18, with all towns on permanent water-saving rules throughout the year.

In 2017–18, 25,690 ML of water was diverted for consumptive purposes (town, domestic and stock, irrigation and commercial supply). This was less than the 38,998 ML diverted in the previous year. Some of the change from the previous year's diversion is related to the reporting of small catchment dam use, which reduced from 23,754 ML last year to only 7,666 ML this year, due to improved hydrological modelling. For more information, see Appendix E.

Water for the environment

Several important environmental assets in the Ovens basin depend on water for the environment, including:

- the lower Ovens River (which contains heritage and iconic reaches), which is an important environmental asset that depends on water in the Ovens basin
- the lower Ovens wetlands, which support egrets, herons, cormorants, bitterns and treecreepers
- the Buffalo River, which is an important site for large fish species during their breeding cycle: trout cod are found as far up the King River as Whitfield
- water from the Ovens basin, which feeds into the Murray basin, helping to maintain the Murray basin's environmental assets.

In 2017–18, water for the environment in the Ovens basin comprised:

- water set aside for the environment and other downstream uses through the operation of passing flows released as a condition of consumptive bulk entitlements held by Goulburn-Murray Water in the regulated rivers
- water set aside for the environment through flow-sharing arrangements set out in North East Water's bulk entitlements in the unregulated rivers
- water set aside for the environment through the operation of passing flow conditions on licensed diversions, including those set out in the *Upper Ovens River WSPA Water Management Plan*
- 123 ML of high-reliability water shares held for the environment
- all other water in the basin not allocated for consumptive use: this water also provides social, recreational and cultural benefits.

In 2017–18, 123 ML of environmental water was delivered in-stream in the Ovens basin.

6.4.3 Water balance

The total volumes of water available and supplied from water resources in the Ovens basin in 2017–18 are shown in Table 6-17.

Table 6-17 Water balance – Ovens basin

Water account component	Note	2017–18 (ML)	2016–17 (ML)
Major on-stream storage			
Volume in storage at start of year	1	25,602	28,512
Volume in storage at end of year	1	27,165	25,602
Change in storage		**1,563**	**(2,910)**
Inflows			
Catchment inflow	2	1,004,579	2,897,251
Rainfall on major storages	1	3,759	4,664
Transfers from Kiewa basin	3	577	0
Treated wastewater discharged back to river	4	1,585	2,281
Total inflows		**1,010,501**	**2,904,196**
Outflows			
Diversions			
Urban diversions		5,531	5,581
Licensed diversions from regulated streams		8,636	5,922
Licensed diversions from unregulated streams		3,858	3,741
Small catchment dams	5	7,666	23,754
Total diversions		***25,690***	***38,997***
Losses			
Evaporation losses from major storages	1	3,806	3,364
Evaporation from small catchment dams	5	4,263	9,184
In-stream infiltration to groundwater, flows to floodplain and evaporation	6	20,646	14,936
Total losses		***28,715***	***27,484***
Water passed at outlet of basin			
Ovens basin outflow to Murray River		954,533	2,840,625
Total water passed at outlet of basin		***954,533***	***2,840,625***
Total outflows		**1,008,938**	**2,907,106**

Notes to the water balance

1. Storages

Major on-stream storages in the Ovens basin are included in the water balance. A breakdown of the volumes presented are in Table 6-18.

Table 6-18 Storage volumes in the Ovens basin

Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Lake Buffalo	23,340	13,147	2,594	2,992	1,004	13,753
Lake William Hovell	13,690	12,455	1,165	814	606	13,412
Total storage volumes 2017–18	**37,030**	**25,602**	**3,759**	**3,806**	**1,610**	**27,165**
Total storage volumes 2016–17	37,030	28,512	4,664	3,364	(4,210)	25,602

2. Catchment inflow

Catchment inflow is the balancing item in this water balance. It is the difference between the total outflows, the known inflows and the net change in storage volume.

3. Transfer to Ovens

The 577 ML transfer represents water that is transferred from the Kiewa basin before being supplied to urban customers in Beechworth.

4. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-19 lists the wastewater treatment plants in the Ovens basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-19 Volume and use of recycled water in the Ovens basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Barnawartha	0	0	0%	0	0	0	0	0	0
Beechworth	292	78	27%	0	78	0	0	214	0
Bright / Porepunkah	369	23	6%	23	0	0	0	346	0
Chiltern	36	36	100%	0	36	0	0	0	0
Glenrowan	10	10	100%	0	10	0	0	0	0
Myrtleford	403	0	0%	0	0	0	0	403	0
Rutherglen / Wahgunyah	127	127	100%	59	69	0	0	0	0
Wangaratta	1,566	1,009	64%	0	1,009	0	0	557	0
Wangaratta Trade Waste	65	0	0%	0	0	0	0	65	0
Total 2017–18	**2,868**	**1,283**	**45%**	**82**	**1,202**	**0**	**0**	**1,585**	**0**
Total 2016–17	3,291	1,010	31%	72	938	0	0	2,281	0

5. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-20 provides information about small catchment dams in the basin.

New hydrological modelling has provided a more-accurate measure of usage and harvested volumes for the 2017–18 reporting period. Therefore, the volumes for small catchment dams in 2016–17 are not directly comparable with the volumes reported for 2017–18. Each year presents the best estimate of the water harvested, used and lost, based on the best information that was available at the time. For more information, see Appendix E and chapter 6.1.2.

Table 6-20 Estimated small catchment dam information for the Ovens basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	26,274	4,975	3,540	8,515
Registered/licensed commercial and irrigation	11,062	2,690	722	3,413
Total 2017–18	**37,336**	**7,666**	**4,263**	**11,928**
Total 2016–17	40,168	23,754	9,184	32,938

6. In-stream losses

The method used to estimate in-stream loss in the Ovens basin used in the 2017–18 accounts has been revised from previous accounts, as chapter 6.1.2 explains. The estimate has changed from a constant average annual volume reported each year (14,936 ML) to an estimate based on streamflow. This has increased the in-stream loss estimate by 38%.

6.4.4 Compliance against entitlements

Compliance against water entitlements is reported in these accounts in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Ovens – Key compliance points
✓ **There was no net increase to the total entitlement volume from the previous year.**
✓ **The total volume diverted (17,447 ML) was within the volume available for the year (57,649 ML).**
✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the Ovens basin provide the basis for how water is shared in the basin. Rights to water in the Ovens basin are outlined in Table 6-21.

Diversions under bulk entitlements are assessed against the Murray–Darling basin annual cap target for the Murray–Kiewa–Ovens valley. Since 2012, cap compliance has been reported to the MDBA through the *Transition Period Water Take Report* (refer to the MDBA's website > Publications). Before this, details of this assessment were published annually in the MDBA's *Water Audit Monitoring Report.*

Table 6-21 Entitlement volumes in the Ovens basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Ovens System – Goulburn-Murray Water) Conversion Order 2004 (1)	
High-reliability water shares	26,194
Spill-reliability water shares	12,525
Bulk Entitlement (Ovens System – Moyhu, Oxley and Wangaratta – North East Water) Conversion Order 2004	7,832
Subtotal: Bulk Entitlement (Ovens System – Goulburn-Murray Water) Conversion Order 2004	**46,551**
Bulk Entitlement (Bright) Conversion Order 2000	870
Bulk Entitlement (Chiltern) Conversion Order 2000	180
Bulk Entitlement (Glenrowan) Conversion Order 1999	90
Bulk Entitlement (Harrietville) Conversion Order 1999	91
Bulk Entitlement (Myrtleford) Conversion Order 2001 (2)	1,470
Bulk Entitlement (Springhurst) Conversion Order 1999	36
Bulk Entitlement (Whitfield) Conversion Order 1999	34
Take and use licences – unregulated surface water	17,223
Total volume of water entitlements in the Ovens basin	**66,545**

Notes

(1) Under this bulk entitlement, Goulburn-Murray Water operates Lake Buffalo and Lake William Hovell to supply to water share holders in the regulated part of the Ovens system and to supply water to North East Water's Ovens system bulk entitlement for Moyhu, Oxley and Wangaratta.

(2) This entitlement specifies that up to 1,470 ML can be diverted in any one year. The maximum volume that can be taken over any two-year period is 2,424 ML (1,212 ML annual average).

Table 6-22 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-22 Available water and take for the Ovens basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Ovens system – Goulburn-Murray Water					
Water shares	-	28,630	0	**28,630**	**8,636**
Ovens system – Moyhu, Oxley and Wangaratta	-	7,832	0	**7,832**	**3,523**
Diversion: Ovens system – Goulburn-Murray Water (2)					**12,159**
Bright	-	870	0	**870**	**870**
Chiltern (3)	-	180	0	**180**	**0**
Glenrowan (4)	-	90	0	**90**	**0**
Harrietville	-	91	0	**91**	**61**
Myrtleford	-	1,212	0	**1,212**	**478**
Springhurst	-	36	0	**36**	**0**
Whitfield	-	34	0	**34**	**22**
Take and use licences – unregulated surface water (5)	-	17,405	169	**17,574**	**3,858**
Total 2017–18	**-**	**57,480**	**169**	**57,649**	**17,447**
Total 2016–17	-	67,748	245	67,993	15,174

Notes

(1) Water use reported includes 123 ML of environmental in-stream use. This amount is not reflected in the water balance in Table 6-17 as it does not reflect an actual diversion from the waterway.

(2) The water use reported in this line item represents the bulk diversion to supply primary entitlements under the Ovens system source bulk entitlement. It includes water delivered in-stream for environmental purposes.

(3) North East Water has not diverted any water under this bulk entitlement since February 2008, when Chiltern was connected to the Wodonga supply system.

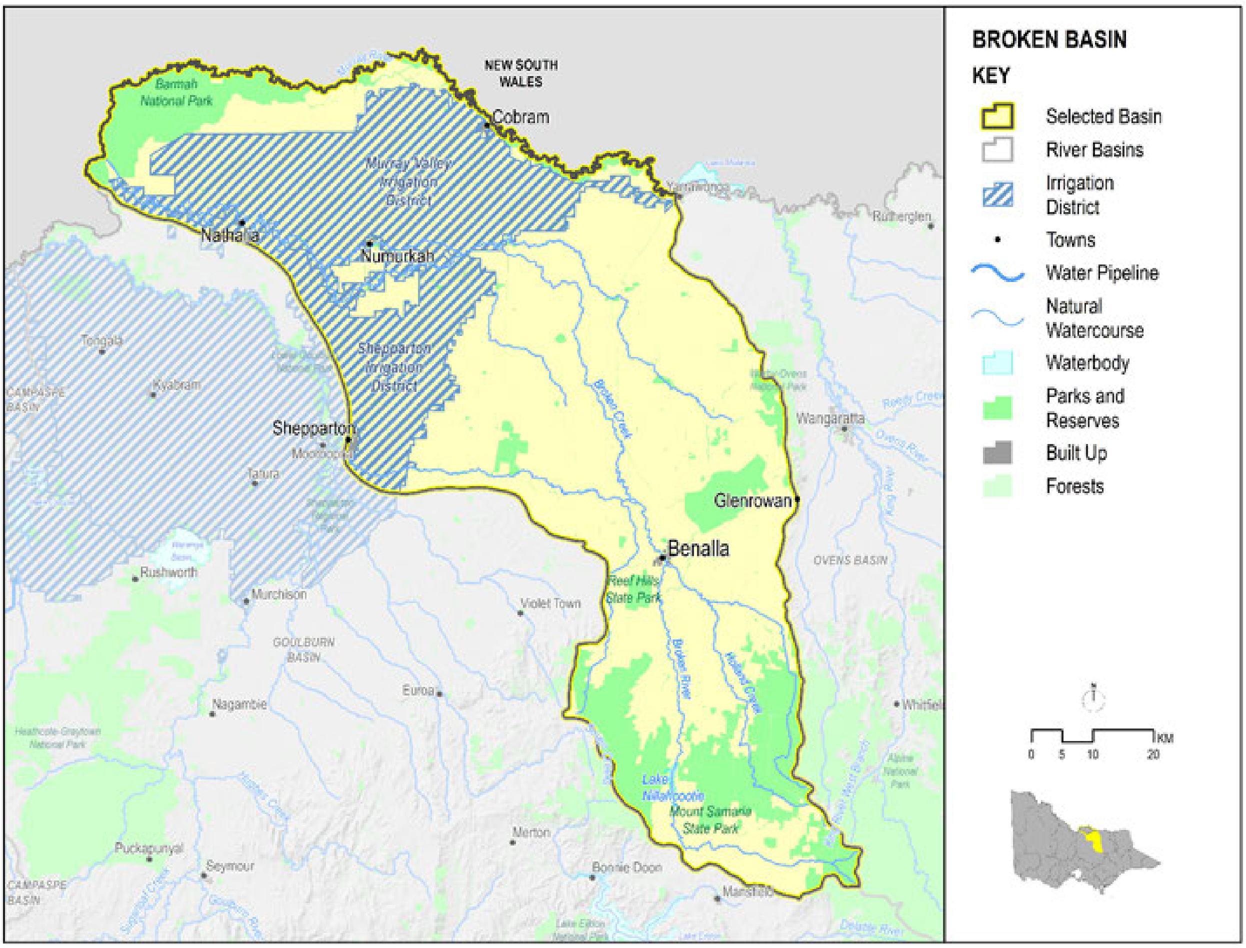
(4) North East Water has not diverted any water under this bulk entitlement since June 2011, when Glenrowan was connected to the Wangaratta supply system.

(5) Net trade encompasses temporary and permanent trades in and out of the Ovens basin. The net value of 169 ML represents water traded in from the Upper Ovens GMU.

6.5 Broken basin

The Broken basin (Figure **6-8**) is located in northern Victoria. It includes the Broken River, which flows into the Goulburn River at Shepparton, and Broken Creek, which flows into the Murray River at Barmah. For the purposes of these water accounts, the Broken basin excludes the Murray Valley Irrigation Area.

Figure 6-8 Map of the Broken basin



6.5.1 Management arrangements

Management of water in the Broken basin is undertaken by various parties, the responsibilities of which Table 6-23 shows.

Table 6-23 Responsibilities for water resources management in the Broken basin

Authority	Management responsibilities
Goulburn-Murray Water	• Supplies primary entitlements for the Broken River and the Tungamah domestic and stock supply system • Manages licensed diversions • Provides bulk water supplies to Goulburn Valley Water and North East Water • Operates Lake Nillahcootie and weirs on Broken River
North East Water	• Supplies towns across most of the Broken basin including Benalla • Operates the Loombah and McCall-Say reservoirs
Goulburn Valley Water	• Supplies towns in the west of the basin including Shepparton, Nathalia and Dookie (sourced from Goulburn and Murray basins)
Goulburn Broken Catchment Management Authority	• Responsible for waterway and catchment management in the region comprising the catchments of the Goulburn and Broken rivers and part of the Murray River valley

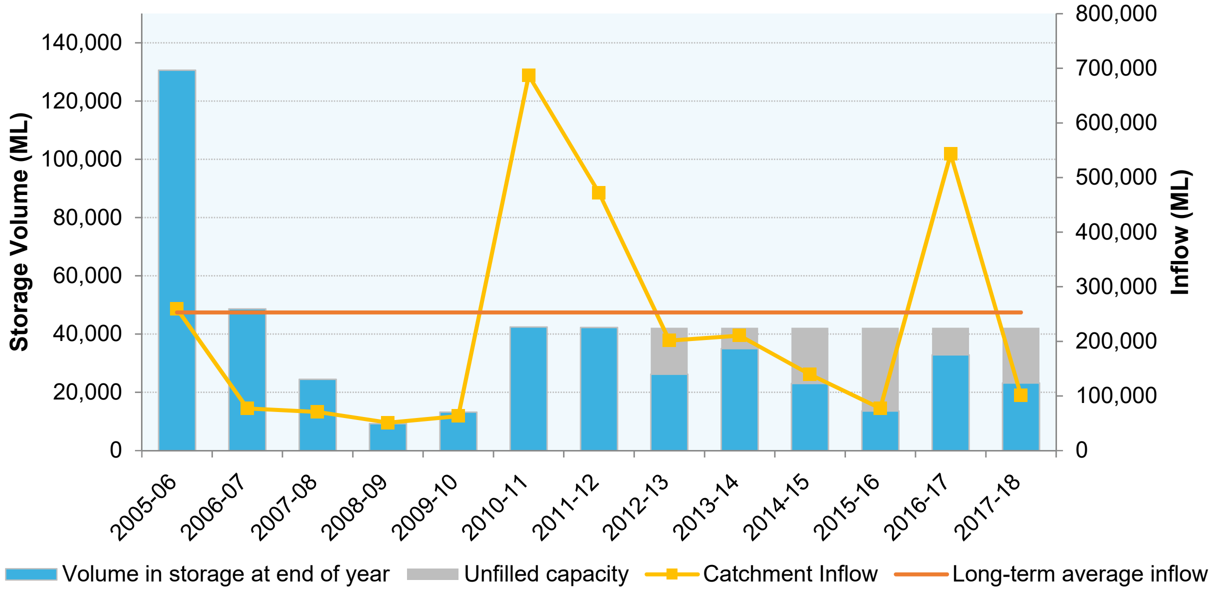
6.5.2 2017–18 Water resource overview

In 2017–18, rainfall across the southern half and northern edge of the Broken basin was 80% to 100% of the long-term average, and most of the northern half received 60% to 80% of the long-term average.

The long-term average used in the 2017–18 accounts has been revised from previous accounts and is now an average of post-1975 streamflow, as chapter 2.2 explains. Catchment inflows in 2017–18 were 40% of the revised long-term average annual volume of 253,089 ML, well below the inflows recorded in 2016–17, which were 215% of the revised long-term average.

Major storages in the Broken basin were at 55% of capacity at the end of the 2017–18, after being at 78% of capacity at the start.

Figure 6-9 Storage volumes and catchment inflows in the Broken basin



Note

(1) Unfilled capacity is not shown on the graph before 2010–11: before then, Lake Mokoan was included as a storage in the Broken basin. Lake Mokoan was decommissioned in 2010 and water supply from this storage ceased, so it is no longer included in the total storage capacity for Broken basin.

The first seasonal determination for high-reliability water shares of 1% was announced on 3 July 2017 and increased to 100% by December 2017. Seasonal determination allocations for low-reliability water shares reached 100% by January 2018.

In 2017–18 three unregulated streams within the Broken basin were subject to restrictions, the same number as the previous year. All licensed diversions from Boosey Creek were banned from August 2017 – June 2018. Licensed diversions were also banned from Hollands Creek and Ryans Creek from January 2018 – June 2018. Licensed diversions on the Lima and Lima East creeks remained unrestricted in 2017–18.

There were no restrictions on urban water use in the Broken basin during 2017–18, with all towns on permanent water-saving rules throughout the year.

In 2017–18, 15,643 ML of water was diverted for consumptive purposes (town, domestic and stock, irrigation and commercial supply). This was less than the 26,511 ML diverted in the previous year. A large portion (16,766 ML) of last year's diversion was the reporting of small catchment dam use, which has reduced this year to 3,379 ML, due to improved hydrological modelling. For more information, see Appendix E.

Water for the environment

Important environmental assets (such as Murray cod, trout cod and significant areas of intact riparian and floodplain vegetation) depend on the Broken basin water for the environment. Sites in the Broken basin (Broken River, Broken Creek, lower Broken Creek and wetlands) depend on environmental water and contain native fish habitat and a wetland of national significance. Water from the Broken basin also feeds into the Goulburn and Murray basins, helping to maintain internationally significant environmental assets within these basins.

In 2017–18, water for the environment in the Broken basin comprised:

- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements held by North East Water and Goulburn-Murray Water
- water set aside for the environment through the operation of passing flow conditions on licensed diversions
- all other water in the basin not allocated for consumptive use: this water also provides social, recreational and cultural benefits
- 534 ML of high-reliability water shares and 4 ML low-reliability water shares held for the environment.

A total of 1,500 ML of environmental water was used in the Broken basin in 2017–18: 500 ML of this was diverted off-stream (to Moodies Swamp) while the remaining 1,000 was delivered in-stream.

6.5.3 Water balance

The total volumes of water available and supplied from water resources in the Broken basin in 2017–18 are shown in Table 6-24.

Table 6-24 Water balance – Broken basin

Water account component	Note	2017–18 (ML)	2016–17 (ML)
Major on-stream storage			
Volume in storage at start of year	1	32,877	13,562
Volume in storage at end of year	1	23,200	32,877
Change in storage		**(9,677)**	**19,315**
Inflows			
Catchment inflow	2	100,536	543,023
Rainfall on major storages	1	4,553	4,741
Treated wastewater discharged back to river	3	0	0
Total inflows		**105,089**	**547,764**
Outflows			
Diversions			
Urban diversions		1,517	1,494
Licensed diversions from regulated streams		9,595	7,738
Licensed diversions from unregulated streams		653	514
Environmental water diversions		500	0
Small catchment dams	4	3,379	16,766
Total diversions		***15,643***	***26,511***
Losses			
Evaporation losses from major storages	1	4,697	4,669
Evaporation from small catchment dams	4	2,800	8,625
In-stream infiltration to groundwater, flows to floodplain and evaporation		12,889	11,568
Total losses		***20,386***	***24,863***
Water passed at outlet of basin			
Broken River at Gowangardie to Goulburn basin		75,011	374,310
Boosey Creek at Tungamah to Murray basin		2,168	76,694
Broken Creek at Katamatite to Murray basin		1,557	26,070
Total water passed at outlet of basin		***78,736***	***477,075***
Total outflows		**114,766**	**528,448**

Notes to the water balance

1. Storages

Major on-stream storages in the Broken basin are included in the water balance. A breakdown of the volumes presented are in Table 6-25.

Table 6-25 Storage volumes in the Broken basin

Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Lake Nillahcootie	40,400	31,130	4,260	3,939	(9,205)	22,246
Loombah McCall-Say	1,747	1,747	293	758	(327)	954
Total storage volumes 2017–18	**42,147**	**32,877**	**4,553**	**4,697**	**(9,532)**	**23,200**
Total storage volumes 2016–17	42,147	13,562	4,741	4,669	19,243	32,877

2. Catchment inflow

Catchment inflow is the balancing item in this water balance. It is the difference between the total outflows, the known inflows and the net change in storage volume.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-26 lists the wastewater treatment plants in the Broken basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-26 Volume and use of recycled water in the Broken basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Benalla	512	512	100%	0	512	0	0	0	0
Tungamah	10	10	100%	0	10	0	0	0	0
Total 2017–18	**522**	**522**	**100%**	**0**	**522**	**0**	**0**	**0**	**0**
Total 2016–17	445	445	100%	0	445	0	0	0	0

4. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-27 provides information about small catchment dams in the basin.

New hydrological modelling has provided a more-accurate measure of usage and harvested volumes for the 2017–18 reporting period. Therefore, the volumes for small catchment dams in 2016–17 are not directly comparable with the volumes reported for 2017–18. Each year presents the best estimate of the water harvested, used and lost, based on the best information that was available at the time. For more information, see Appendix E and chapter 6.1.2.

Table 6-27 Estimated small catchment dam information for the Broken basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	16,851	2,034	2,267	4,301
Registered/licensed commercial and irrigation	8,802	1,345	533	1,877
Total 2017–18	**25,654**	**3,379**	**2,800**	**6,179**
Total 2016–17	27,599	16,766	8,625	25,391

6.5.4 Compliance against entitlements

Compliance against water entitlements is reported in these accounts in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Broken – Key compliance points

- ✓ **There was no net increase to the total entitlement volume from the previous year.**
- ✓ **The total volume diverted (13,264 ML) was within the volume available for the year (22,565 ML).**
- ✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
- ✓ **Individual bulk entitlement holders complied with all provisions in their entitlements apart from:**
  - ✗ **during regulated conditions, the losses for Broken Creek were 2,331 ML above the annual average allowance of 1,850 ML under the *Bulk Entitlement (Broken System Goulburn-Murray Water) Conversion Order 2004*. Ongoing issues with the Broken Creek allowance have been recognised, and Goulburn-Murray Water are working with DELWP to rectify the issue.**

Entitlements in the Broken basin provide the basis for how water is shared in the basin. Rights to water in the Broken basin are outlined in Table 6-28.

Entitlements to water in the regulated part of the Broken basin provide for the right to carry over unused allocation to the next season. These entitlement holders can carry over unused water up to 50% of their entitlement volume.

Diversions under bulk entitlements in the Broken basin are assessed against the Murray–Darling basin annual cap target for the Goulburn–Broken–Loddon valley. Since 2012, cap compliance has been reported to the MDBA through the *Transition Period Water Take Report* (refer to the MDBA's website > Publications). Before this, details of this assessment were published annually in the MDBA's *Water Audit Monitoring Report.*

Table 6-28 Entitlement volumes in the Broken basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Broken System – Goulburn-Murray Water) Conversion Order 2004 (1)	
High-reliability water shares	17,625
Low-reliability water shares	3,345
Bulk Entitlement (Broken System – Tungamah Devenish and St James – North East Water) Conversion Order 2004	135
Broken supplement to Lower Goulburn and Murray (2)	n/a
Loss allowance	1,850
Subtotal: Bulk Entitlement (Broken System Goulburn-Murray Water) Conversion Order 2004	**22,955**
Bulk Entitlement (Loombah McCall-Say) Conversion Order 2001	2,324
Take and use licences – unregulated surface water	2,716
Total (30 June 2018)	**27,995**
Total (30 June 2017)	**27,997**

Notes

(1) Under this bulk entitlement, Goulburn-Murray Water operates Lake Nillahcootie to supply water share holders in the regulated part of the Broken system and to supply water to North East Water's bulk entitlement for Tungamah, Devenish and St James.

(2) Supplementary supply to the lower Goulburn and Murray systems is provided when low-reliability allocations have reached 100% and surplus water remains in the Broken system.

n/a Not applicable.

Table 6-29 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-29 Available water and take for the Broken basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Broken system – Goulburn-Murray Water					
Water shares	7,165	13,801	(5,505)	**15,462**	**6,914**
Tungamah, Devenish and St James (1)	64	71	0	**135**	**0**
Broken supplement to Lower Goulburn and Murray					**0**
Loss allowance (2)					**4,181**
Diversion: Broken system – Goulburn-Murray Water (3)					**11,095**
Loombah McCall-Say (Benalla)	0	2,324	0	**2,324**	**1,517**
Take and use licences – unregulated surface water	0	2,795	0	**2,795**	**653**
Total 2017–18	**7,229**	**18,991**	**(5,505)**	**20,715**	**13,264**
Total 2016–17	3,683	22,628	(4,361)	21,950	11,462

Notes

(1) North East Water transferred its offtake for this bulk entitlement to upstream of Benalla Weir in October 2009, but does not yet have infrastructure in place to supply water under this entitlement. In 2017–18, these towns continued to be supplied with water via a pipeline from Yarrawonga in the Murray system.

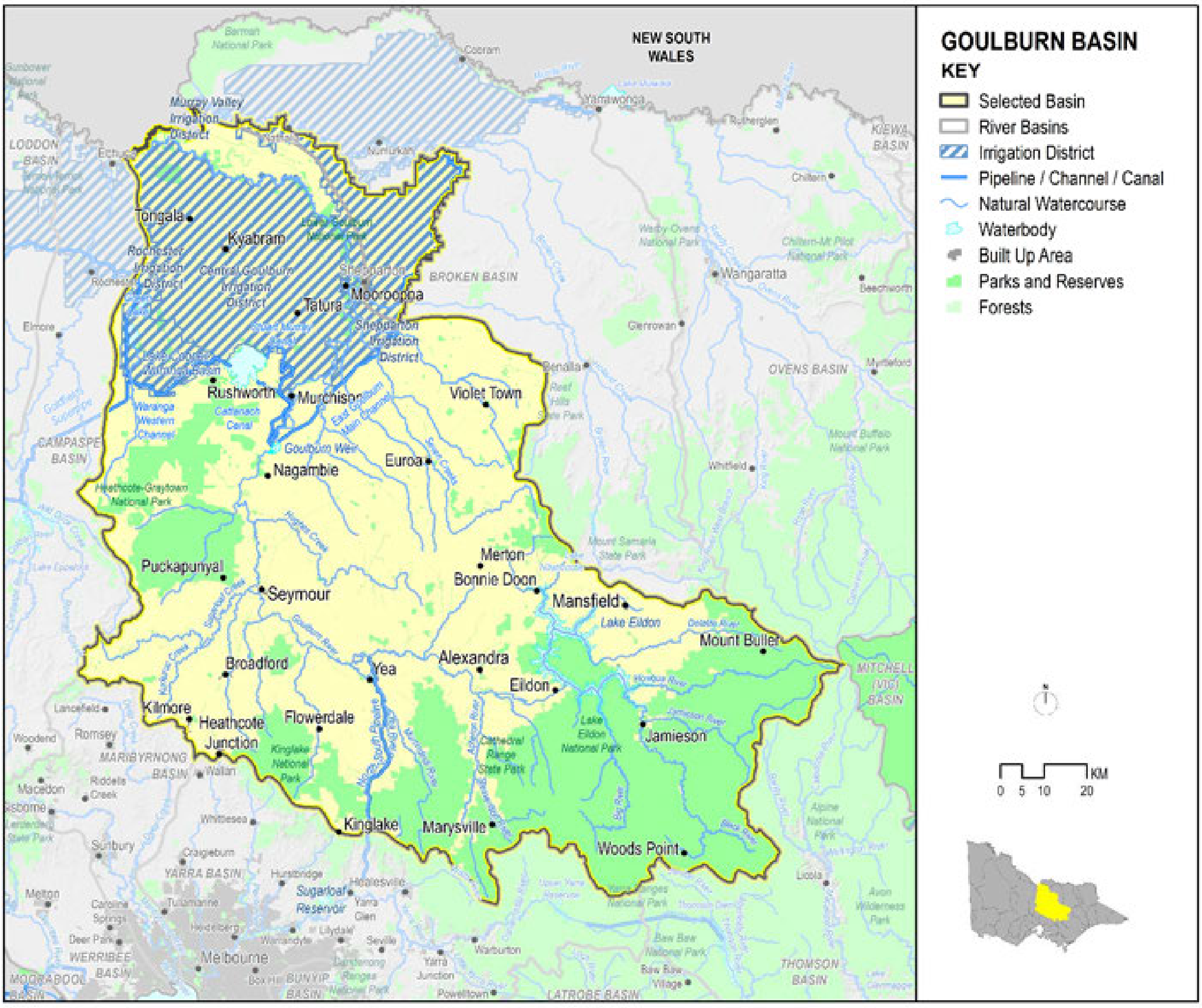
(2) Goulburn-Murray Water has an annual average loss allowance of 1,850 ML. In 2017–18, Goulburn-Murray Water reported that during regulated conditions, the losses from Broken Creek were 2,331 ML over the loss allowance.

(3) The water use reported in this line item represents the bulk diversion during regulated conditions to supply primary entitlements under the Broken system source bulk entitlement. It includes environment deliveries in-stream (1,000 ML) as well as environmental diversions off-stream (500 ML to Moodies Swamp).

6.6 Goulburn basin

The Goulburn basin (Figure 6-10) is located in northern Victoria and extends from the Great Dividing Range near Woods Point to the Murray River near Echuca in the north-west.

Figure 6-10 Map of the Goulburn basin



6.6.1 Management arrangements

Management of water in the Goulburn basin is undertaken by various parties, the responsibilities of which Table 6-30 shows.

Table 6-30 Responsibilities for water resources management in the Goulburn basin

Authority	Management responsibilities
Goulburn-Murray Water	• Supplies Central Goulburn Irrigation District, Rochester Irrigation Area and Shepparton Irrigation Area • Manages surface water diversions • Delivers bulk supplies to many of Goulburn Valley Water's towns and some of Coliban Water's towns • Operates lakes Eildon and Nagambie and the Waranga basin
Goulburn Valley Water	• Supplies towns located in the Goulburn basin including Shepparton, Alexandra and Seymour
Coliban Water	• Can supply towns located in the Loddon and Campaspe basins from the Goulburn basin including Bendigo
Melbourne Water	• Operates the Silver–Wallaby diversion system to Melbourne
Grampians Wimmera Mallee Water	• Supplies Quambatook
Goulburn Broken Catchment Management Authority	• Responsible for waterway and catchment management in the whole of the Goulburn basin

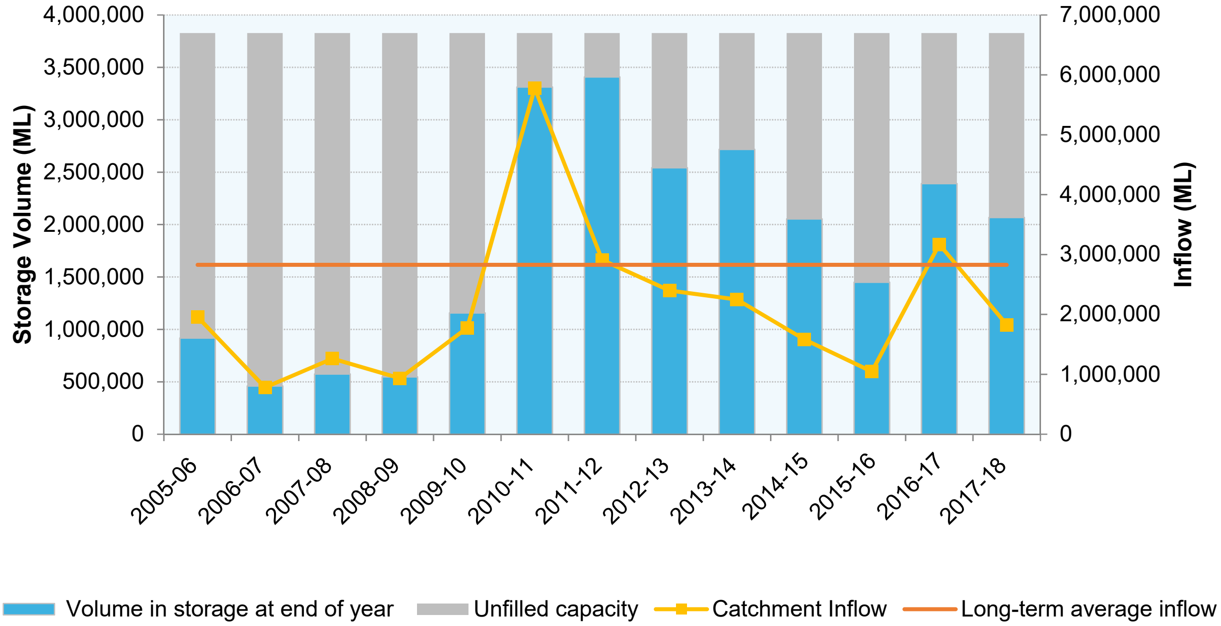
6.6.2 2017–18 Water resource overview

In 2017–18, rainfall across most of the Goulburn basin was between 80% and 100% of the long-term average. Areas over Euroa in the centre, Eildon in the south-east corner and Kilmore in the south-west corner received between 100% and 125% of the long-term average rainfall.

The long-term average used in the 2017–18 accounts has been revised from previous accounts and is now an average of post-1975 streamflow, as chapter 2.2 explains. Catchment inflows were 65% of the revised long-term average (2,827,303 ML): less than the inflows recorded in 2016–17, which were 112% of the revised long-term average.

The volume of water in major storages in the Goulburn basin started the year at 63% of capacity and ended the year at 54% of capacity.

Figure 6-10 Storage volumes and catchment inflows in the Goulburn basin



The opening seasonal allocation for high-reliability water shares was announced on 3 July 2017 at 36% and reached 100% by December 2017. There was no seasonal allocation for low-reliability water shares in 2017–18.

Restrictions continued from the previous year for Stony Creek, Sunday Creek and Wallaby Creek, with licensed diversion banned during July 2017 and stage 3 restrictions in the Yea River and its tributaries. All bans and rosters were lifted in August 2017, except for Sunday Creek which remained under ban for the entirety of 2017–18. Bans on licensed diversions from Wallaby Creek were reinstated from December 2017 to June 2018. From March 2018, Stony Creek's ban was reinstated for the remainder of the year, and Yea River and its tributaries' stage 3 roster was implemented until the end of May 2018. Licensed diversion from Seven Creeks was banned for the month of March 2018.

No urban water-use restrictions applied in the Goulburn basin in 2017–18, with all towns on permanent water-savings rules throughout the year.

In 2017–18, 1,070,467 ML of water was diverted for consumptive purposes (town, domestic and stock, irrigation and commercial supply). This was more than the 765,086 ML diverted in the previous year. Some of the change from the previous year's diversion is related to the reporting of small catchment dam use, which reduced from 47,106 ML last year to only 17,258 ML this year, due to improved hydrological modelling. For more information, see Appendix E.

Water for the environment

Important environmental assets (such as wetlands of national significance, significant areas of intact riparian and floodplains vegetation and endangered flora and fauna species including trout cod and Murray cod) depend on water for the environment in the Goulburn basin. Water from the Goulburn basin also flows into the Murray and Loddon basins, helping to maintain internationally significant environmental assets (such as Gunbower Forest and the Hattah Lakes within the Murray basin). Sites in the Goulburn basin that rely on water for the environment include:

- the lower Goulburn River (downstream of Goulburn Weir) which contains a wetland of national significance, native fish habitat and floodplain national park
- Reedy Swamp, a regionally significant wetland that is part of the Lower Goulburn National Park and which contains drought refuge and significant habitat for colonial nesting birds.

In 2017–18, water sourced from the Goulburn basin for the environment comprised:

- the *Environmental Entitlement (Goulburn System – Living Murray 2007)*, comprising 39,625 ML of high-reliability and 156,980 ML of low-reliability entitlements held by the VEWH
- the *Goulburn River Environmental Entitlement 2010*, comprising 8,851 ML of high-reliability and 3,140 ML of low-reliability entitlements held by the VEWH
- the *Environmental Entitlement (Goulburn System – NVIRP Stage 1) 2012* comprising 34,255 ML held by the VEWH, which includes mitigation water allocated for the purposes of watering specific environmental sites that

have been identified through the Goulburn-Murray Water Connections Project environmental approvals processes

- the *Bulk Entitlement (Goulburn System – Snowy Environment Reserve) Order 2004*, comprising 30,252 ML of high-reliability and 8,156 ML of low-reliability entitlements
- up to 7,490 ML of water each year, as part of the *Bulk Entitlement (Loddon River – Environmental Water Reserve) Order 2005*
- 299,085 ML of high-reliability water shares and 60,319 ML of low-reliability water shares held for the environment
- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements (regulated and unregulated systems) held by Goulburn Valley Water and Goulburn-Murray Water
- water set aside for the environment through the operation of passing flow conditions on licensed diversions
- the *Silver and Wallaby Creeks Environmental Entitlement 2006*, which provides passing flow rules on Silver and Wallaby creeks
- all other water in the basin not allocated for consumptive use: this water also provides social, recreational and cultural benefits.

A total of 376,434 ML of environmental water was used in the Goulburn basin in 2017–18: 500 ML of this was diverted off-stream while the remaining 375,934 ML was delivered in-stream.

6.6.3 Water balance

The total volumes of water available and supplied from water resources in the Goulburn basin in 2017–18 are shown in Table 6-31.

Table 6-31 Water balance – Goulburn basin

Water account component	Note	2017–18 (ML)	2016–17 (ML)
Major on-stream storage			
Volume in storage at start of year	1	2,141,867	1,204,968
Volume in storage at end of year	1	1,849,267	2,141,867
Change in storage		**(292,600)**	**936,899**
Inflows			
Catchment inflow	2	1,843,383	3,170,647
Rainfall on major storages	1	91,551	86,181
Inflow from Broken River at Gowangardie		75,011	374,310
Inflow from Loddon via the Goulburn supplement		8,554	22,747
Return flow from irrigation		0	0
Transfer from Campaspe via Waranga Western Channel		15,643	0
Treated wastewater discharged back to river	3	1,584	2,293
Total inflows		**2,035,727**	**3,656,178**
Outflows			
Diversions			
Urban diversions		26,751	24,772
Irrigation district diversions		1,009,917	664,576
Licensed diversions from regulated streams		18,527	12,766
Licensed diversions from unregulated streams		6,798	12,790
Transfer from Silver and Wallaby creeks to Yarra basin		757	3,058
Transfers to Melbourne via the North–South Pipeline	4	7	18
Environmental water diversions		500	0
Small catchment dams	5	17,258	47,106
Total diversions		***1,080,515***	***765,086***
Losses			
Evaporation losses from major storages	1	176,787	94,669
Evaporation from small catchment dams	5	11,463	17,243
In-stream infiltration to groundwater, flows to floodplain and evaporation		129,548	93,438
Total losses		***317,797***	***205,350***
Water passed at outlet of basin			
Goulburn River to Campaspe River via Waranga Western Channel		0	55
Goulburn River outflow to Murray River		912,754	1,741,785
Goulburn River outflow to Murray River via Broken Creek		17,260	7,004
Total water passed at outlet of basin		***930,014***	***1,748,844***
Total outflows		**2,328,327**	**2,719,279**

Notes to the water balance

1. Storages

Major on-stream storages in the Broken basin are included in the water balance. A breakdown of the volumes presented are in Table 6-32. Volumes in off-stream storages are presented for additional information about the resource condition.

Table 6-32 Storage volumes in the Goulburn basin

Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Goulburn Weir	25,500	24,123	5,175	88,314	82,837	23,821
Lake Eildon	3,334,158	2,116,778	86,271	88,314	(290,270)	1,824,465
Sunday Creek Reservoir	1,650	966	105	159	69	981
Total on-stream storages	**3,361,308**	**2,141,867**	**91,551**	**176,787**	**(207,364)**	**1,849,267**
Off-stream storages						
Greens Lake	32,500	22,599	969	5,091	2,329	20,806
Waranga basin	432,360	227,170	24,238	81,516	27,727	197,619
Total off-stream storages	**464,860**	**249,769**	**25,207**	**86,607**	**30,056**	**218,425**
Total storage volumes 2017–18	**3,826,168**	**2,391,636**	**116,758**	**263,394**	**(177,308)**	**2,067,692**
Total storage volumes 2016–17	3,826,168	1,449,598	122,023	163,087	983,102	2,391,636

2. Catchment inflow

Catchment inflow is the balancing item in this water balance. It is the difference between the total outflows, the known inflows and the net change in storage volume.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-33 lists the wastewater treatment plants in the Goulburn basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

In addition to the recycled water reported below, 120 ML was returned from the Mount Buller Resort to Black Dog Creek and other waterways during the water year.

Table 6-33 Volume and use of recycled water in the Goulburn basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Alexandra	179	179	100%	144	35	0	0	0	0
Avenel	23	23	100%	0	23	0	0	0	0
Bonnie Doon	21	21	100%	0	21	0	0	0	0
Broadford	106	106	100%	0	106	0	0	0	0
Eildon	125	121	97%	121	0	0	0	4	0
Euroa	260	244	94%	67	177	0	0	16	0
Girgarre	0	0	0%	0	0	0	0	0	0
Kilmore	485	388	80%	0	388	0	0	97	0
Kyabram / Merrigum	447	447	100%	0	447	0	0	0	0
Mansfield	354	238	67%	75	163	0	0	116	0
Marysville	49	49	100%	49	0	0	0	0	0
Mooroopna	965	965	100%	0	965	0	0	0	0
Murchison	0	0	0%	0	0	0	0	0	0
Nagambie	85	85	100%	0	85	0	0	0	0
Seymour	492	377	77%	68	309	0	0	115	0
Shepparton	3,679	2,602	71%	0	2,602	0	0	1,077	0
Stanhope / Rushworth	96	58	60%	0	58	0	0	38	0
Tatura	870	870	100%	0	870	0	0	0	0
Tongala	262	262	100%	0	262	0	0	0	0
Upper Delatite	61	61	100%	0	61	0	0	0	0
Violet Town	30	30	100%	0	30	0	0	0	0
Yea	106	106	100%	55	51	0	0	0	0
Total 2017–18	**8,695**	**7,232**	**83%**	**579**	**6,653**	**0**	**0**	**1,463**	**0**
Total 2016–17	7,308	5,166	71%	436	4,728	0	0	2,144	0

4. Inter-basin transfers

7 ML of usage was recorded against Yarra Valley Water's Goulburn system bulk entitlement. This water was used to maintain the operational capacity of the Sugarloaf Pipeline and keep the pipeline charged for firefighting purposes.

5. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-34 provides information about small catchment dams in the basin.

New hydrological modelling has provided a more-accurate measure of usage and harvested volumes for the 2017–18 reporting period. Therefore, the volumes for small catchment dams in 2016–17 are not directly comparable with the volumes reported for 2017–18. Each year presents the best estimate of the water harvested, used and lost, based on the best information that was available at the time. For more information, see Appendix E and chapter 6.1.2.

Table 6-34 Estimated small catchment dam information for the Goulburn basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	51,204	11,292	9,674	20,966
Registered/licensed commercial and irrigation	22,638	5,966	1,788	7,754
Total 2017–18	**73,842**	**17,258**	**11,463**	**28,721**
Total 2016–17	79,443	47,106	17,243	64,349

6.6.4 Compliance against entitlements

Compliance against water entitlements is reported in these accounts in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Goulburn – Key compliance points

- ✓ **There was a net increase to the total entitlement volume from the previous year. This increase was allowed under the situations below.**
  - **An increase was made to the volume of high-reliability water shares (5,324 ML) and low-reliability water shares (13,032 ML), with a corresponding decrease in loss allowances during 2017–18. The issue of new water shares was a result of water recovery achieved under Stage 2 of the Goulburn-Murray Water Connections Project. In issuing the water savings, Goulburn loss allowances were reduced; but as the shares were issued after the final seasonal determination and the close of the irrigation season (in April), the revised loss allowances only apply for compliance purposes from 2018-19. Other minor changes to the water share volume resulted from the conversion of two supply by agreements to water shares (13.5 ML high-reliability and 6.5 ML low-reliability) and the surrender of one water share (2 ML).**
  - **An increase was made to the volume of unregulated take and use licences (124 ML) during 2017–18, to correct an error in the issuing of the original licences.**
- ✓ **The total volume diverted (1,439,190 ML) was within the volume available for the year (1,725,894 ML).**
- ✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
- ✓ **Individual bulk entitlement holders complied with all provisions in their entitlements apart from:**
  - ✗ **a minor noncompliance with waterworks district loss allowance under the under the *Bulk Entitlement (Eildon – Goulburn Weir) Conversion Order 1995* due to an error in the bulk entitlement, which has subsequently been corrected**
  - ✗ **no approved metering plan has been implemented for the *Bulk Entitlement (Quambatook – Grampians Wimmera Mallee Water) Order 2006***

Entitlements in the Goulburn basin provide the basis for how water is shared in the basin. Rights to water in the Goulburn basin are outlined in Table 6-35.

Melbourne Water holds a bulk entitlement to divert surface water from the Silver and Wallaby creeks. This entitlement is one of four which contribute to the Greater Yarra system – Thomson River Pool which primarily supplies Melbourne and supports regional urban water corporations Barwon Water, Western Water, South Gippsland Water and Westernport Water (Table 6-104 and Table 6-105).

Entitlements (except some waterworks districts entitlements) to water in the regulated system of the Goulburn basin provide for the right to carry over unused allocation to the next season. In the Goulburn basin, these entitlement holders can carry over unused water up to 100% of their entitlement volume. Water held above entitlement volume is also subject to a risk of spill; there were no spill events in 2017–18 affecting customers' spillable water accounts.

The VEWH holds *Bulk Entitlement (Goulburn System – Snowy Environmental Reserve) Order 2004* in trust for the Snowy River. Allocation to the entitlement is traded from the VEWH's account to the Snowy Scheme so it can be subsequently released from the Snowy Scheme to support the health of the Snowy and Murray rivers.

Table 4-5 has information about this entitlement.

Diversions under bulk entitlements are assessed against the Murray–Darling basin annual cap target for the Goulburn–Broken–Loddon valley. Since 2012, cap compliance has been reported to the MDBA through the *Transition Period Water Take Report* (refer to the MDBA's website > Publications). Before this, details of this assessment were published annually in the MDBA's *Water Audit Monitoring Report.*

Table 6-35 Entitlement volumes in the Goulburn basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Eildon – Goulburn Weir) Conversion Order 1995 (1)	
High-reliability water shares	1,051,563
Low-reliability water shares	469,084
High-reliability supply by agreements	4,472
Low-reliability supply by agreements	1,845
Waterworks districts (2)	2,290
Bulk Entitlement (Quambatook – Grampians Wimmera Mallee Water) Order 2006	100
BE (Goulburn Channel System – Coliban Water) Order 2012	2,420
BE (Goulburn River and Eildon – Goulburn Valley Water) Order 2012	26,299
BE (Goulburn Channel System – Goulburn Valley Water) Order 2012	7,191
Goulburn system – Melbourne metropolitan retailers	
Bulk Entitlement (Goulburn System – City West Water) Order 2012 (3)	n/a
Bulk Entitlement (Goulburn System – South East Water) Order 2012 (3)	n/a
Bulk Entitlement (Goulburn System – Yarra Valley Water) Order 2012 (3)	n/a
Subtotal: Goulburn system – Melbourne metropolitan retailers	**n/a**
Environmental Entitlement (Goulburn System – Living Murray) 2007	
Living Murray - high-reliability entitlement (4)	39,625
Living Murray - low-reliability entitlement (4)	156,980
Subtotal: Environmental Entitlement (Goulburn System – Living Murray) 2007	**196,605**
Environmental Entitlement (Goulburn System – NVIRP Stage 1) 2012 (5)	n/a
Bulk Entitlement (Goulburn System – Snowy Environmental Reserve) Order 2004	
Snowy high-reliability entitlement (4)	30,252
Snowy low-reliability entitlement (4)	8,156
Subtotal: Bulk Entitlement (Goulburn System – Snowy Environmental Reserve) Order 2004	**38,408**
Goulburn River Environmental Entitlement 2010	
Goulburn River high-reliability environmental entitlement (4)	8,851
Goulburn River low-reliability environmental entitlement (4)	3,140
Subtotal: Environmental Entitlement (Goulburn System – Living Murray) 2007	**11,991**
Goulburn supplement to Broken Creek (4)(6)	40,000
Goulburn supplement to Little Lake Boort (4)(6)	300
Loddon system – Wimmera-Mallee Pipeline savings entitlement (4)(6)	7,490
Goulburn water quality reserve (4)(6)	30,000
Goulburn exchange rate trade commitment (4)	105,875
Loss allowance – irrigation districts (7)	316,210
Subtotal: Bulk Entitlement (Eildon – Goulburn Weir) Conversion Order 1995	**2,312,143**
Bulk Entitlement (Broadford, Kilmore and Wallan) Conversion and Augmentation Order 2003 (8)	2,875
Bulk Entitlement (Buxton) Conversion Order 1995	110
Bulk Entitlement (Euroa System) Conversion Order 2001	1,990
Bulk Entitlement (Longwood) Conversion Order 1995	120
Bulk Entitlement (Mansfield) Conversion Order 1995	1,300
Bulk Entitlement (Marysville) Conversion Order 1995	462
Bulk Entitlement (Pyalong) Conversion Order 1997	75
Bulk Entitlement (Strathbogie) Conversion Order 2012	23
Bulk Entitlement (Thornton) Conversion Order 1995	120
Bulk Entitlement (Upper Delatite) Conversion Order 1995	235
Bulk Entitlement (Violet Town) Conversion Order 1997	20

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Woods Point) Conversion Order 1995	30
Bulk Entitlement (Yea) Conversion Order 1997	438
Bulk Entitlement (Rubicon – Southern Hydro Ltd) Conversion Order 1997 (9)	n/a
Bulk Entitlement (Silver and Wallaby Creeks – Melbourne Water) Order 2014 (10)	22,000
Silver and Wallaby Creeks Environmental Entitlement 2006 (11)	n/a
Take and use licences – unregulated surface water	24,089
Total (30 June 2018)	**2,366,030**
Total (30 June 2017) (12)	**2,347,560**

Notes

(1) Under Goulburn-Murray Water's Eildon – Goulburn Weir bulk entitlement, the water corporation operates the Goulburn system to supply Goulburn system water share holders, bulk entitlements held by Coliban Water, Goulburn Valley Water and Grampians Wimmera Mallee Water for towns supplied from irrigation districts, and entitlements held by the Melbourne metropolitan retail water corporations and the VEWH.

(2) This includes the volume of water to supply water allowance holders in the Normanville, Tungamah, East Loddon and West Loddon waterworks districts. It excludes the specified volume of water of loss allowance in these districts as well as the volume of water required to supply Grampians Wimmera Mallee Water and Coliban Water's bulk entitlements via these districts.

(3) Together, these entitlements provide City West Water, South East Water and Yarra Valley Water with a total annual allocation of water equal to one-third of the phase 3 Goulburn water savings achieved in the previous year under the Goulburn-Murray Water Connections Project stage 1; a specified volume has not been included.

(4) 2017–18 is the first year that the components of these entitlements have been reported in the accounts. This detail has been included to provide more clarity about the entitlement, and it does not represent a change in the entitlement. These changes do not represent an increase to the volume of water entitlement, rather, to show a more-complete view of all the possible volumes available under the entitlements.

(5) This entitlement provides the VEWH with a total annual allocation of water equal to one-third of the phase 3 Goulburn water savings achieved in the previous year under the Goulburn-Murray Water Connections Project stage 1.

(6) These are additional supplies (or supplements) the Goulburn system is required to provide to the Broken Creek and Loddon systems and for water quality in the Goulburn system. Schedule 3 of Goulburn-Murray Water's Eildon – Goulburn Weir bulk entitlement sets out the conditions for these supplies to be provided. Supply of the Loddon system – Wimmera Mallee Pipeline entitlement is supplied to the VEWH in accordance with VEWH's *Bulk Entitlement (Loddon River – Environmental Reserve) Order 2005*

(7) This represents the maximum loss allowance as outlined in the bulk entitlement including loss allowances in the Normanville, East Loddon and Tungamah waterworks districts. The actual loss allowed will vary year to year, based on the rules in the bulk entitlement, actual delivery volumes, carryover or headroom allowance. This loss allowance applied until after the last seasonal determination in April 2018 when it was revised (2 April 2018) as a result of the issue of water recovered as part of the Goulburn-Murray Water Connections Project Stage 2. For compliance purposes, the loss allowance that applied for 2017–18 (that is, the loss allowance before 2 April 2018) has been included here.

(8) This entitlement specifies that up to 2,875 ML can be diverted in any one year. The maximum volume that can be taken over any 10-year period is 22,380 ML (2,238 ML annual average).

(9) The Rubicon–Hydro bulk entitlement held by AGL Hydro Ltd is for non-consumptive purposes and therefore a specified volume has not been included. Water diverted under this entitlement is returned to the watercourse.

(10) Melbourne Water holds a 22,000 ML bulk entitlement on the Silver and Wallaby creeks. Compliance with a three-year diversion limit of 66,000 ML is assessed using a three-year rolling total diversion. This water is used to supply primary entitlement holders (City West Water, South East Water, Yarra Valley Water, Barwon Water, Western Water, South Gippsland Water and Westernport Water) with entitlement to the Greater Yarra system – Thomson River Pool which sources water from the Yarra River, Thomson River, Tarago River, Silver Creek and Wallaby Creek.

(11) The *Silver and Wallaby Creeks Environmental Entitlement 2006* specifies the volume of environmental (passing) flows required to be released for Silver Creek and Wallaby Creek, so a specified volume has not been included.

(12) The total volume reported for 30 June 2017 differs from the volume reported in the 2016–17 accounts to reflect the volume that would have been reported if all the components of the entitlements reported this year were included.

n/a Not applicable.

Table 6-36 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-36 Available water and take for the Goulburn basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Eildon – Goulburn Weir					
Water shares	620,705	1,046,240	(453,620)	**1,213,325**	**806,156**
Supply by agreements	3,128	4,476	(1,234)	**6,370**	**3,849**
Waterworks districts (1)	-	2,632	(2)	**2,630**	**1,181**
Quambatook – Grampians Wimmera Mallee Water	95	100	(30)	**165**	**73**
Goulburn channel system – Coliban Water	1,127	2,420	(2,000)	**1,547**	**1,166**
Goulburn River and Eildon – Goulburn Valley Water (2)	2	26,568	(4,875)	**21,696**	**16,324**
Goulburn channel system – Goulburn Valley Water	174	7,191	(1,000)	**6,365**	**5,269**
Goulburn system – Melbourne retailers	27,199	16,440	(22,796)	**20,843**	**7**
Environmental entitlement Goulburn system – Living Murray (3)	34,261	39,625	5,559	**79,445**	**77,559**
Goulburn system – NVIRP Stage 1 (3)	32,707	21,066	1,151	**54,924**	**34,733**
Goulburn system – Snowy Environmental Reserve	0	30,252	(30,252)	**0**	**0**
Goulburn River environmental entitlement (3)	2,983	8,851	253,474	**265,308**	**264,142**
Loss allowance – irrigation district					**141,267**
Operating provisions (whole of system) (4)					**75,990**

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Diversion: Eildon – Goulburn Weir (5)					**1,427,716**
Broadford, Kilmore and Wallan	-	2,238	0	**2,238**	**1,593**
Buxton	-	110	0	**110**	**0**
Euroa system	-	1,990	0	**1,990**	**784**
Longwood	-	120	0	**120**	**58**
Mansfield	-	1,300	0	**1,300**	**732**
Marysville	-	462	0	**462**	**348**
Pyalong	-	75	0	**75**	**45**
Strathbogie	-	23	0	**23**	**7**
Thornton	-	120	0	**120**	**0**
Upper Delatite	-	235	0	**235**	**117**
Violet Town	-	20	0	**20**	**0**
Woods Point	-	30	0	**30**	**8**
Yea	-	438	0	**438**	**227**
Rubicon – Hydro Ltd	-	0	0	**0**	**0**
Silver and Wallaby creeks – Melbourne Water	-	22,000	0	**22,000**	**757**
Silver and Wallaby Creeks Environmental Entitlement	-	-	-	-	-
Take and use licences – unregulated surface water	-	24,117	(1)	**24,116**	**6,798**
Total 2017–18	**722,380**	**1,259,139**	**(255,625)**	**1,725,894**	**1,439,190**
Total 2016–17	386,644	1,263,047	(28,524)	1,621,167	717,963

Notes

(1) Reported volumes relate to water allowance holders and delivery losses. Water available under Coliban Water and Grampians Wimmera Mallee Water's bulk entitlements in the waterworks districts are excluded from this line item (and reported against those bulk entitlements).

(2) The volume of allocation issued includes return flows of 269 ML, credited to Goulburn Valley Water for return flows from Goulburn-Murray Water customers.

(3) The water use reported under these entitlements is primarily in-stream use and is therefore not included as a diversion from the waterway in the Goulburn system water balance. The amount of use under the Goulburn system – NVIRP stage 1 entitlement also includes 500 ML diverted to Gaynors Swamp.

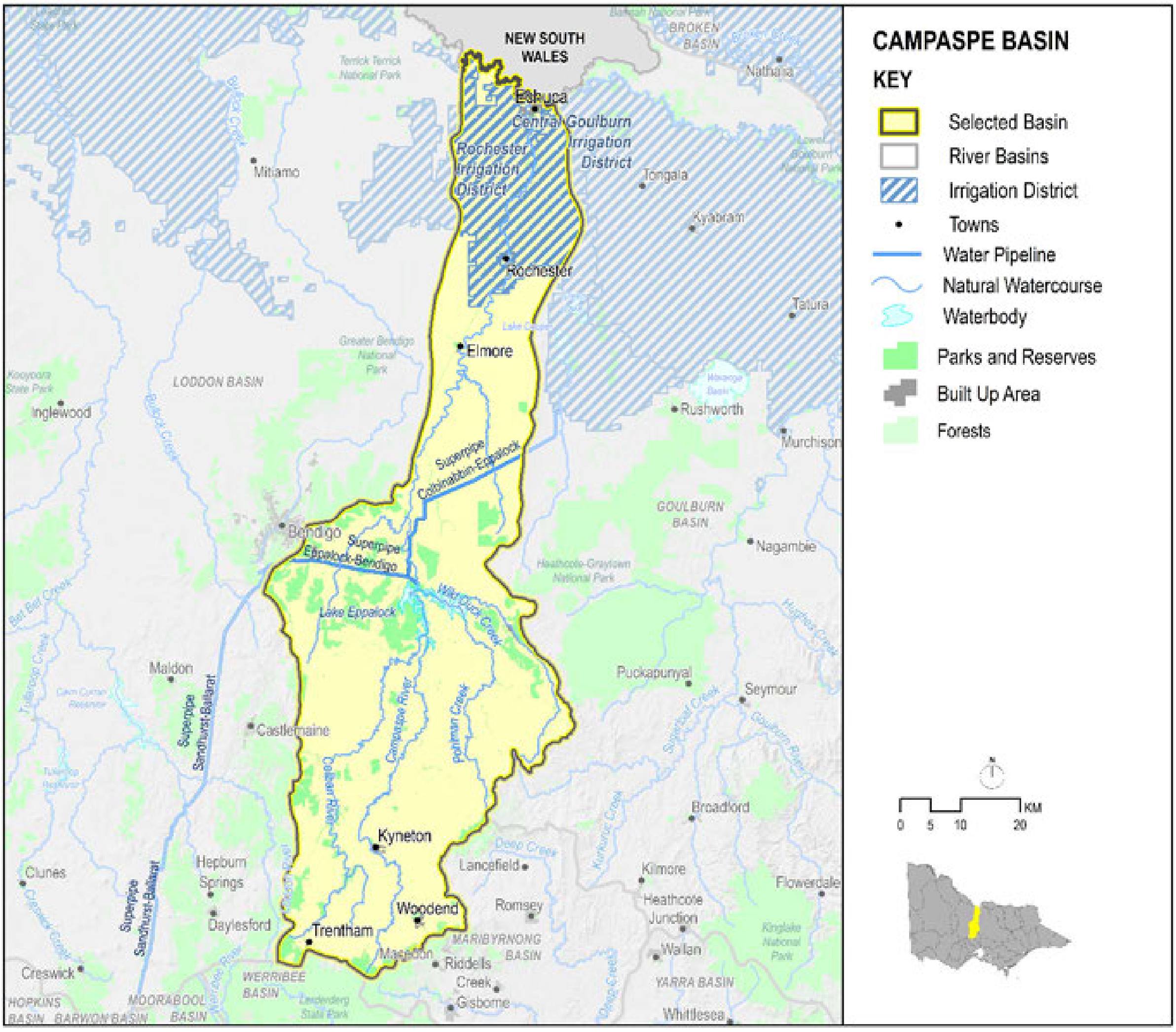
(4) This reflects use of water to manage the system including the net transfer of water to off-stream storages — Waranga basin and Greens Lake — as well as water supplied to the Campaspe, Loddon and Murray rivers during the water year.

(5) The water use reported in this line item represents the bulk diversion to supply primary entitlements and fulfil other operating requirements under the Goulburn system source bulk entitlement. It includes environment deliveries in-stream (375,934 ML) as well as environmental diversions off-stream (500 ML to Gaynors Swamp).

6.7 Campaspe basin

The Campaspe basin (Figure 6-11) is located in north-central Victoria. It extends 150 km south from the Murray River to the Great Dividing Range and is 45 km across at its widest point.

Figure 6-11 Map of the Campaspe basin



6.7.1 Management arrangements

Management of water in the Campaspe basin is undertaken by various parties, the responsibilities of which Table 6-37 shows.

Table 6-37 Responsibilities for water resources management in the Campaspe basin

Authority	Management responsibilities
Goulburn-Murray Water	• Supplies Rochester Irrigation District and Campaspe area • Manages licensed diversions • Provides bulk water supply to Coliban Water • Operates Lake Eppalock
Coliban Water	• Provides irrigation and domestic and stock supplies off the Coliban Main Channel • Supplies urban water for most of the Campaspe basin including Echuca, Rochester and Kyneton • Operates Upper Coliban, Lauriston and Malmsbury reservoirs
Western Water	• Supplies urban water for Woodend at the southern end of the basin
North Central Catchment Management Authority	• Responsible for waterway and catchment management in the whole of the Campaspe basin

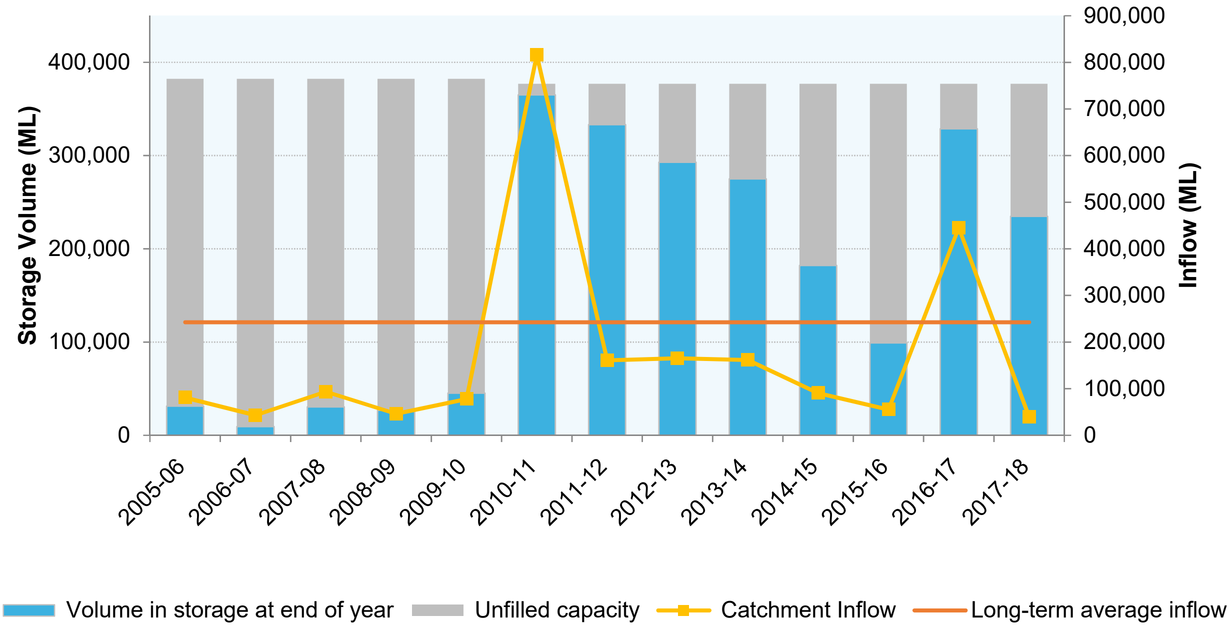
6.7.2 2017–18 Water resource overview

In 2017–18, rainfall in the centre of the Campaspe basin, north of Lake Eppalock and south of Rochester, was mostly between 60% and 80% of the long-term average. All other parts of the basin received between 80% and 100% of the long-term average.

The long-term average used in the 2017–18 accounts has been revised from previous accounts and is now an average of post-1975 streamflow, as chapter 2.2 explains. Catchment inflows were 16% of the revised long-term average (242,570 ML): less than the inflows recorded in 2016–17, which were 184% of the revised long-term average.

The volume of water in major storages in the Campaspe basin was 87% of capacity at 1 July 2017 and 62% at 30 June 2018.

Figure 6-12 Storage volumes and catchment inflows in the Campaspe basin



In 2017–18, the first seasonal allocation for high-reliability water shares was announced on 3 July 2017 at 100%. Seasonal allocations for low-reliability water shares were announced at 0% in July 2017, but gradually increased through the year with a final determination of 59% in April 2018.

In the Campaspe basin, 16 unregulated streams began the year with bans on licensed diversions in place. These were lifted at the end of July 2017 for all except Wanalta Creek, which remained under ban for the entirety of 2017–18. The number of streams restricted increased from two to seven between September and November 2017. This number increased significantly in December, when diversions were banned on 13 streams. By March 2018, this number increased to 17, all of which remained in place for the rest of the year. Only four out of 21 unregulated streams in the Campaspe basin remained unrestricted for the 2017–18 year.

No urban water-use restrictions were applied in the Campaspe basin in 2017–18, with all towns on permanent water-saving rules throughout the year.

In 2017–18, 60,693 ML of water was diverted for consumptive purposes (town, domestic and stock, irrigation and commercial supply). This was more than the 55,768 ML diverted in the previous year. Some of the change from the previous year's diversion is related to the reporting of small catchment dam use, which reduced from 22,032 ML last year to only 7,210 ML this year, due to improved hydrological modelling. For more information, see Appendix E.

Water for the environment

Important environmental assets (such as endangered flora and fauna species including Murray cod and painted snipe and communities of threatened riparian vegetation) depend on water for the environment in the Campaspe basin. Water from the Campaspe basin also feeds into the Murray basin, helping to maintain internationally significant environmental assets (such as Gunbower Forest and Kerang Wetlands).

In 2017–18, water for the environment in the Campaspe basin comprised:

- the *Campaspe River Environmental Entitlement 2013* comprising 20,652 ML of high-reliability and 2,966 ML of low-reliability entitlements held by the VEWH
- the *Environmental Entitlement (Campaspe River – Living Murray Initiative) 2007* comprising 126 ML of high-reliability and 5,048 ML of low-reliability entitlements held by the VEWH
- 6,594 ML of high-reliability water shares and 395 ML low-reliability water shares held for the environment
- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements held by Coliban Water, Western Water and Goulburn-Murray Water
- water set aside for the environment through the operation of passing flow conditions on licensed diversions
- all other water in the basin not allocated for consumptive use: this water also provides social, recreational and cultural benefits.

In 2017–18, a total of 29,584 ML of environmental water was delivered in-stream in the Campaspe basin.

6.7.3 Water balance

The total volumes of water available and supplied from water resources in the Campaspe basin in 2017–18 are shown in Table 6-38.

Table 6-38 Water balance – Campaspe basin

Water account component	Note	2017–18 (ML)	2016–17 (ML)
Major on-stream storage			
Volume in storage at start of year	1	328,640	99,005
Volume in storage at end of year	1	234,792	328,640
Change in storage		**(93,848)**	**229,635**
Inflows			
Catchment inflow	2	39,477	445,441
Rainfall on major storages	1	36,060	36,546
Transfer from Waranga Western Channel to Lake Eppalock		0	55
Transfer to Campaspe basin from Waranga Western Channel		82	0
Treated wastewater discharged back to river	3	720	1,124
Total inflows		**76,339**	**483,166**
Outflows			
Diversions			
Urban diversions		19,577	18,197
Diversion for Coliban Water rural entitlements		8,594	5,976
Licensed diversions from regulated streams		9,576	7,515
Licensed diversions from unregulated streams		661	690
Small catchment dams	4	7,210	22,032
Transfer from Campaspe basin to Western Waranga Channel		0	0
Transfer from Campaspe basin to White Swan Reservoir		0	1,359
Total diversions		***45,618***	***55,768***
Losses			
Evaporation losses from major storages		18,506	24,748
Evaporation from small catchment dams	4	5,796	14,794
In-stream infiltration to groundwater, flows to floodplain and evaporation		5,872	4,421
Total losses		***30,174***	***43,963***
Water passed at outlet of basin			
Campaspe River outflows to Murray River	5	94,395	153,801
Total water passed at outlet of basin		***94,395***	***153,801***
Total outflows		**170,187**	**253,532**

Notes to the water balance

1. Storages

Major on-stream storages in the Campaspe basin are included in the water balance. A breakdown of the volumes presented are in Table 6-39.

Table 6-39 Storage volumes in the Campaspe basin

Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Campaspe Weir	2,624	2,706	n/a	n/a	(267)	2,439
Lake Eppalock	304,651	271,479	34,018	10,737	(109,284)	185,476
Lauriston Reservoir	19,790	17,250	672	2,037	(186)	15,700
Malmsbury Reservoir	12,034	1,942	623	1,741	1,912	2,735
Upper Coliban Reservoir	37,770	35,263	747	3,991	(3,577)	28,442
Total storage volumes 2017–18	**376,869**	**328,640**	**36,060**	**18,506**	**(111,402)**	**234,792**
Total storage volumes 2016–17	374,245	96,364	36,546	24,748	217,771	328,640

Note
n/a Not applicable.

2. Catchment inflow

Catchment inflow is the balancing item in this water balance. It is the difference between the total outflows, the known inflows and the net change in storage volume.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-40 lists the wastewater treatment plants in the Campaspe basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-40 Volume and use of recycled water in the Campaspe basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Axedale	17	17	100%	17	0	0	0	0	0
Echuca	1,718	1,718	100%	0	1,718	0	0	0	0
Elmore	0	0	0%	0	0	0	0	0	0
Heathcote	128	128	100%	128	0	0	0	0	0
Kyneton	793	316	40%	67	249	0	0	478	0
Lockington	0	0	0%	0	0	0	0	0	0
Rochester	0	0	0%	0	0	0	0	0	0
Woodend	321	79	24%	41	37	0	1	242	0
Total 2017–18	**2,977**	**2,258**	**76%**	**253**	**2,004**	**0**	**1**	**720**	**0**
Total 2016–17	2,358	1,234	52%	194	1,039	0	1	1,124	0

4. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-41 provides information about small catchment dams in the basin.

New hydrological modelling has provided a more-accurate measure of usage and harvested volumes for the 2017–18 reporting period. Therefore, the volumes for small catchment dams in 2016–17 are not directly comparable with the volumes reported for 2017–18. Each year presents the best estimate of the water harvested, used and lost, based on the best information that was available at the time. For more information, see Appendix E and chapter 6.1.2.

Table 6-41 Estimated small catchment dam information for the Campaspe basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	29,717	5,772	5,252	11,024
Registered/licensed commercial and irrigation	6,520	1,438	544	1,982
Total 2017–18	**36,237**	**7,210**	**5,796**	**13,006**
Total 2016–17	39,212	22,032	20,317	42,349

5. Water passed at outlet of basin

This volume is the gauged flow from the Campaspe River to the Murray River, measured at Rochester downstream of Waranga Western Channel.

It includes the 29,462 ML delivered via the Campaspe inter-valley transfer account and 15,643 ML delivered via the Goulburn inter-valley transfer account: both amounts were delivered directly to the Murray River.

6.7.4 Compliance against entitlements

Compliance against water entitlements is reported in these accounts in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Campaspe – Key compliance points
✓ **There was no net increase to the total entitlement volume from the previous year.**
✓ **The total volume diverted (83,638 ML) was within the volume available for the year (121,878 ML).**
✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
✓ **Individual bulk entitlement holders complied with all provisions in their entitlements apart from:**
✗ **four days of minimum-flow noncompliance occurred during the year under the Campaspe system – Goulburn-Murray Water bulk entitlement, due to fluctuations in calculated inflows.**

Entitlements in the Campaspe basin provide the basis for how water is shared in the basin. Rights to water in the Campaspe basin are outlined in Table 6-42.

Entitlements to water in regulated systems in the Campaspe basin provide for the right to carry over unused allocation to the next season. In the Campaspe basin, these entitlement holders can carry over unused water up to 100% of their entitlement volume; any unused water above this amount is written off as an end-of-season forfeiture. Water held above entitlement volume is also subject to a risk of spill.

Diversions under these bulk entitlements are assessed against the Murray–Darling basin annual cap target for the Campaspe valley. Since 2012, cap compliance has been reported to the MDBA through the *Transition Period Water Take Report* (refer to the MDBA's website > Publications). Before this, details of this assessment were published annually in the MDBA's *Water Audit Monitoring Report.*

Table 6-42 Entitlement volumes in the Campaspe basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Campaspe System – Goulburn-Murray Water) Conversion Order 2000 (1)	
High-reliability water shares	23,465
Low-reliability water shares	19,175
Bulk Entitlement (Axedale Goornong and Rochester) Conversion Order 1999 (2)	349
Environmental Entitlement (Campaspe River – Living Murray Initiative) 2007 (3)	
Campaspe River Living Murray high-reliability entitlement	126
Campaspe River Living Murray low-reliability entitlement	5,048
Subtotal: Environmental Entitlement (Campaspe River – Living Murray Initiative) 2007	**5,174**
Campaspe River Environmental Entitlement 2013 (3)	
High-reliability entitlement	18,996
Fixed reliability entitlement	1,656
Low-reliability water shares	2,966
Subtotal: Campaspe River Environmental Entitlement 2013	**23,618**
Provision for system operation (4)	11,809
Subtotal: Bulk Entitlement (Campaspe System – Goulburn-Murray Water) Conversion Order 2000	**83,590**
Bulk Entitlement (Campaspe System – Coliban Water) Conversion Order 1999 (5)	
Rural entitlements	15,742
Urban commitments	34,518
Subtotal: Bulk Entitlement (Campaspe System – Coliban Water) Conversion Order 1999	**50,260**
Bulk Entitlement (Trentham) Conversion Order 2012 (6)	120
Bulk Entitlement (Woodend) Conversion Order 2004	470
Take and use licences – unregulated surface water	2,921
Total (30 June 2018)	**137,361**
Total (30 June 2017)	**137,574**

Notes

(1) Under this bulk entitlement, Goulburn-Murray Water releases water from Lake Eppalock to supply water share holders in the Campaspe system, to supply Coliban Water's Axedale and Goornong bulk entitlement and to supply the VEWH's environmental entitlement. The water that Goulburn-Murray Water may take is limited to an average annual volume of 83,590 ML over any consecutive 10-year period.

(2) Coliban Water may take, under its Axedale, Goornong and Rochester bulk entitlement, a maximum annual volume of 215 ML for Axedale and Goornong and an average of 134 per annum over any consecutive 10-year period for Rochester.

(3) 2017–18 is the first year that the components of these entitlements have been reported in the accounts. This detail has been included to provide more clarity about the entitlement, and it does not represent a change in the entitlement. Any increase to the overall entitlement also does not represent an actual increase to the volume of water entitlement; rather, it provides a more-complete view of all the possible volumes available under the entitlements

(4) This volume includes an allowance for volume supplied to the Goulburn system via the Campaspe supplement.

(5) Under this bulk entitlement, Coliban Water releases water from Lake Eppalock, Lauriston Reservoir, Malmsbury Reservoir and Upper Coliban Reservoir to supply rural and urban commitments. The water that Coliban Water may take is limited to an average annual volume of 50,260 ML over any consecutive three-year period.

(6) Coliban Water can take, under the Trentham bulk entitlement, an average of 120 ML per year over a three-year period.

Table 6-43 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-43 Permitted and actual take for the Campaspe basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Campaspe system – Goulburn-Murray Water					
Water shares	15,086	34,778	(28,074)	**21,790**	**9,579**
Axedale, Goornong and Rochester	58	349	(260)	**147**	**65**
Campaspe River – Living Murray Initiative (1)	5,174	3,104	0	**8,278**	**5,300**
Campaspe River Environmental Entitlement (1)	4,586	22,402	3,594	**30,582**	**24,284**
Operating provisions (whole of system) (2)					**15,643**
Diversion: Campaspe system – Goulburn-Murray Water (3)					**54,870**
Campaspe system – Coliban Water					
Rural entitlements	-	21,048	0	**21,048**	**4,632**
Urban commitments	-	36,518	0	**36,518**	**14,967**
Operating provisions (whole of system)	-	0	0	**0**	**8,137**
Diversion: Campaspe system – Coliban Water					**27,736**
Trentham	-	120	0	**120**	**86**
Woodend	-	470	0	**470**	**285**
Take and use licences – unregulated surface water	-	2,913	12	**2,925**	**661**
Total 2017–18	**24,903**	**121,703**	**(24,728)**	**121,878**	**83,638**
Total 2016–17	21,332	125,768	(29,609)	117,491	32,378

Notes

(1) The water use reported under these two entitlements is in-stream use. It is not included as a diversion for the purposes of the Campaspe basin water balance in Table 6-38.

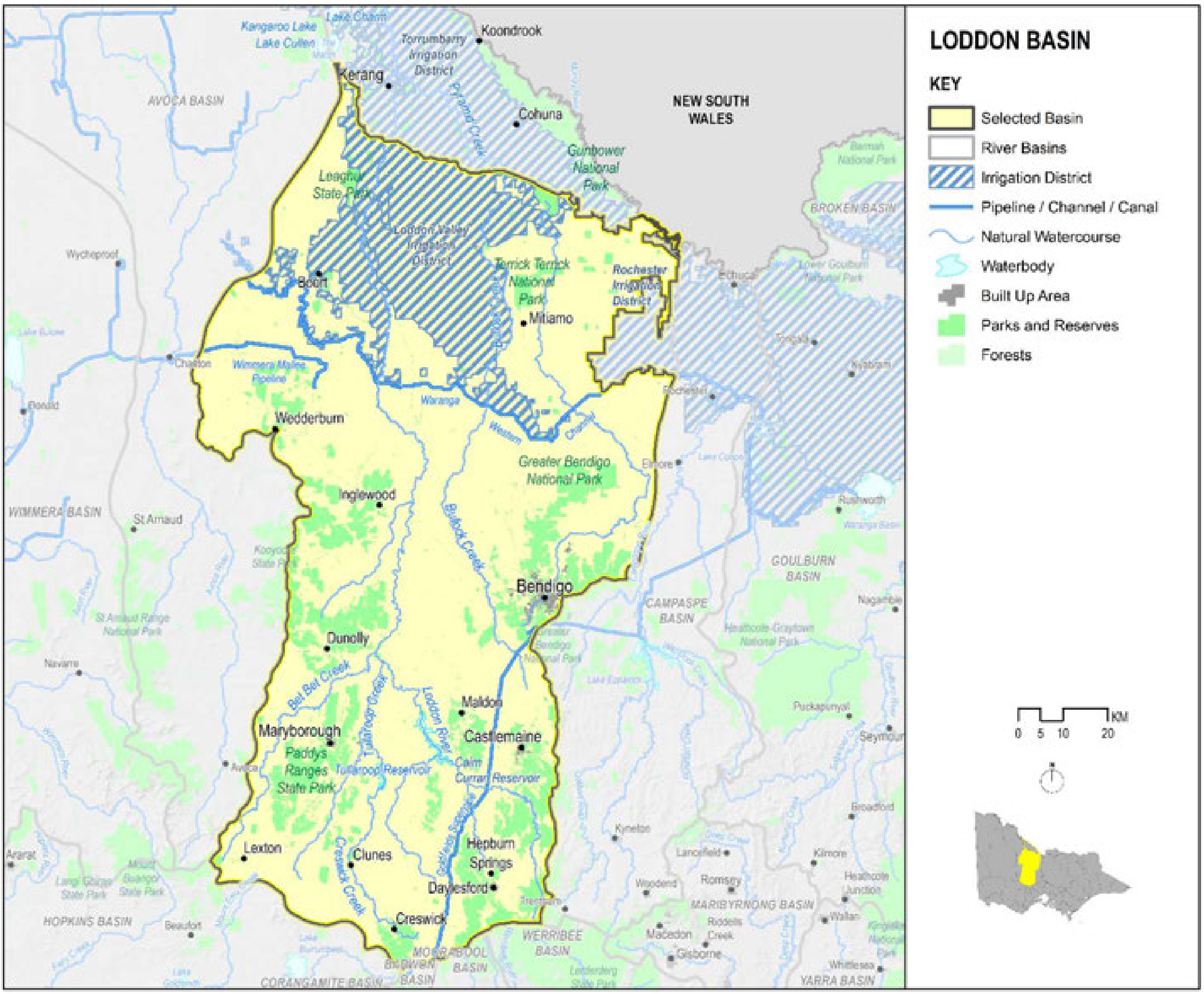
(2) The water taken under the operating provision refers to system losses and water made available to the Goulburn system via the Goulburn supplement. As there are no irrigation areas or districts in the Campaspe system there is zero loss (the volume of diversion and delivery are the same). In 2017–18, a supplement was provided to the Goulburn system (15,643 ML).

(3) The water taken reported in this line item represents the bulk diversion to supply primary entitlements and fulfil other operating requirements under the Campaspe system source bulk entitlement. It includes environment deliveries in-stream (29,584 ML).

6.8 Loddon basin

The Loddon basin (Figure 6-13) is located in northern Victoria and includes the Loddon River, Bullock Creek and Bendigo Creek. The basin is crossed by the Waranga Western Channel, which provides water to users in the Loddon basin from the Goulburn basin (that is, the Loddon Valley Irrigation Area). For the purposes of the Loddon water balance, the Loddon basin excludes the Torrumbarry Irrigation Area (supplied mostly from the Murray River) and the Loddon Valley Irrigation Area.

Figure 6-13 Map of the Loddon basin



6.8.1 Management arrangements

Management of water in the Loddon basin is undertaken by various parties, the responsibilities of which Table 6-44 shows.

Table 6-44 Responsibilities for water resources management in the Loddon basin

Authority	Management responsibilities
Goulburn-Murray Water	• Supplies the Loddon Valley Irrigation Area and domestic and stock supplies in Normanville, East Loddon and West Loddon waterworks districts sourced from the Goulburn basin • Manages licensed diversions • Provides bulk supply to Coliban Water for towns supplied from the Loddon, Campaspe and Goulburn systems including Pyramid Hill, Boort and Bendigo • Operates major reservoirs including Cairn Curran, Laanecoorie, Tullaroop, Hepburn Lagoon and Newlyn reservoirs
Grampians Wimmera Mallee Water	• Provides bulk supply to Coliban Water for towns supplied from the Wimmera Mallee system (Borung, Korong Vale, Wedderburn and Wychitella)
Central Highlands Water	• Supplies towns in the southern part of the Loddon basin including Maryborough, Daylesford, Creswick and Clunes
Coliban Water	• Supplies towns in the eastern and northern parts of the Loddon basin including Bendigo, Castlemaine, Wedderburn, Mitiamo, Pyramid Hill and Boort
North Central Catchment Management Authority	• Responsible for waterway and catchment management in the whole of the Loddon basin

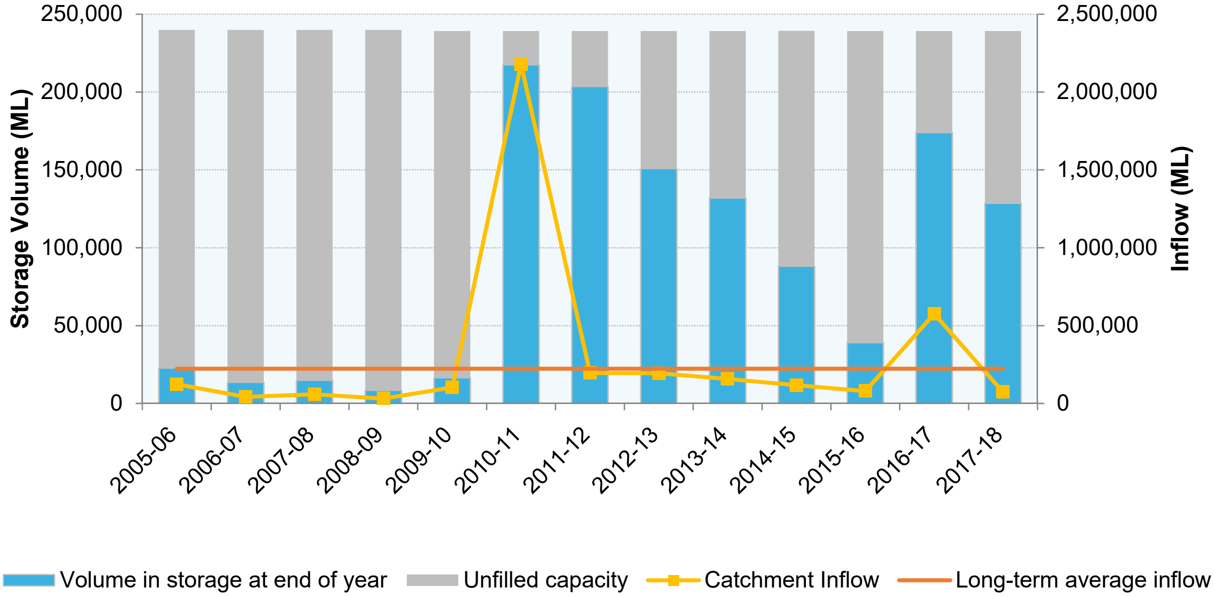
6.8.2 2017–18 Water resource overview

In 2017–18, rainfall in the north and south of the basin was mostly between 80% to 100% of the long-term average, with the centre of the basin receiving between 60% and 80% of the long-term average.

The long-term average inflow presented in these 2017–18 accounts has been revised from previous accounts and is now an average of post-1975 streamflow, as chapter 2.2 explains. Catchment inflows in 2017–18 were 33% of the revised long-term average annual volume of 223,184 ML: less than the inflows recorded in 2016–17, which were 258% of the revised long-term average.

The volume of water in major storages in the Loddon basin was 73% of capacity at the start of the year, and after below-average rainfall was received storages were 54% full by the end of June 2018.

Figure 6-14 Storage volumes and catchment inflows in the Loddon basin



On 3 July 2017, allocations for high-reliability water shares were announced at 30% allocation in the Loddon system. This increased to 100% by December 2017. No allocations were made to low-reliability water shares during the year. The Bullarook system received an initial allocation of 0% for high-reliability water shares, which reached 100% by 15 August 2017. Low-reliability water shares also reached 100% by 1 September 2017.

On 3 July 2017, Coliban Water announced a 2017–18 seasonal determination of 100% for its rural system.

In July 2017, there were still restrictions on licensed diversions on 22 streams. These restrictions were lifted on all but two streams by July and August 2017. Restrictions on diversions were in place on eight streams by November, with this number increasing to 24 by December 2017. The number of streams with bans on licensed diversions increased over the summer, with a peak of 27 in March 2018. All of these bans except four continued for the remainder of 2017–18.

No urban water-use restrictions applied in the Loddon basin in 2017–18, with all towns on permanent water-saving rules throughout the year.

In 2017–18, 42,196 ML of water were diverted from the Loddon basin for consumptive purposes (town, domestic and stock, irrigation and commercial supply). This was less than the 82,783 ML diverted in the previous year. Some of the change from the previous year's diversion is related to the reporting of small catchment dam use, which reduced from 39,361 ML last year to only 7,475 ML this year, due to improved hydrological modelling. For more information, see Appendix E.

Water for the environment

Important environmental assets (such as endangered flora and fauna species including Murray cod and painted snipe and communities of threatened riparian vegetation) depend on water for the environment in the Loddon basin. Water from the Loddon basin also feeds into the Murray basin, helping to maintain internationally significant Ramsar-listed environmental assets including the Kerang Wetlands.

The Kerang Wetlands support over 150 flora species and over 50 waterbird species including the endangered freckled duck and little bittern. Tullaroop Creek in the Loddon River system also has a population of regionally significant blackfish.

In 2017–18, water for the environment sourced from the Loddon basin comprised:

- the *Bulk Entitlement (Loddon River – Environmental Water Reserve) Order 2005*, which includes 3,480 ML high-reliability, 2,024 ML of low-reliability and 7,490 ML of provisional-reliability entitlements, passing flows and river freshening flows held by the VEWH

- The *Environmental Entitlement (Birch Creek – Bullarook System) 2009*, which includes passing flows and 100 ML of water in Newlyn Reservoir when high-reliability water shares are greater than 20% in the Bullarook system at the start of December
- 3,826 ML of high-reliability water shares and 527 ML low-reliability water shares held for the environment
- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements held by Central Highlands Water and Goulburn-Murray Water
- water set aside for the environment through the operation of passing flow conditions on licensed diversions
- all other water in the basin not allocated for consumptive use: this water also provides social, recreational and cultural benefits.

A total of 16,876 ML of environmental water was used in the Loddon basin in 2017–18: 3,047 ML of this was diverted off-stream while the remaining 13,829 ML was delivered in-stream.

6.8.3 Water balance

The total volumes of water available and supplied from water resources in the Loddon basin in 2017–18 are shown in Table 6-45.

Table 6-45 Water balance – Loddon basin

Water account component	Note	2017–18 (ML)	2016–17 (ML)
Major on-stream storage			
Volume in storage at start of year	1	170,572	35,319
Volume in storage at end of year	1	124,501	170,572
Change in storage		**(46,071)**	**135,253**
Inflows			
Catchment inflow	2	73,071	575,121
Rainfall on major storages	1	10,631	16,944
Treated wastewater discharged back to river	3	5,645	6,405
Total inflows		**89,347**	**598,470**
Outflows			
Diversions			
Urban diversions		4,119	3,706
Licensed diversions and irrigation diversions from regulated streams		16,545	11,194
Transfer to Goulburn basin (through Loddon supplement)		8,554	22,747
Licensed diversions from unregulated streams		5,403	5,775
Environmental water diversions		3,047	0
Small catchment dam use	4	7,475	39,361
Total diversions		***45,144***	***82,782***
Losses			
Evaporation losses from major storages	1	29,006	34,507
Evaporation from small catchment dams	4	6,624	33,918
In-stream infiltration to groundwater, flows to floodplain and evaporation	5	20,536	19,302
Total losses		***56,166***	***87,727***
Water passed at outlet of basin			
Loddon River outflow to Murray River (Appin South)		30,008	214,327
Wandella Creek at Fairley		0	5,905
Mount Hope Creek at Mitiamo		4,082	35,725
Bullock Creek, Calivil Creek and Nine Mile Creek		18	36,751
Total water passed at outlet of basin		***34,107***	***292,707***
Total outflows		**135,418**	**463,217**

Notes to the water balance

1. Storages

Major on-stream storages in the Loddon basin are included in the water balance. A breakdown of the volumes presented are in Table 6-46. Volumes in off-stream storages are presented for additional information about the resource condition.

Table 6-46 Storage volumes in the Loddon basin

Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Cairn Curran Reservoir	147,130	110,233	5,370	18,073	(19,802)	77,728
Hepburn Lagoon	2,457	1,598	512	1,270	338	1,178
Laanecoorie Reservoir	8,000	3,190	1,842	1,524	(488)	3,020
Newlyn Reservoir	3,012	2,063	314	780	(43)	1,554
Tullaroop Reservoir	72,950	53,488	2,593	7,359	(7,701)	41,021
Total on-stream storages	**233,549**	**170,572**	**10,631**	**29,006**	**(27,696)**	**124,501**
Off-stream storages						
Evansford Reservoir	1,346	996	106	275	182	1,009
Sandhurst Reservoir	2,595	1,375	426	264	643	2,180
Spring Gully Reservoir	1,680	1,044	425	277	(275)	917
Total off-stream storages	**5,621**	**3,415**	**957**	**816**	**550**	**4,106**
Total storage volumes 2017–18	**239,170**	**173,987**	**11,588**	**29,822**	**(27,146)**	**128,607**
Total storage volumes 2016–17	239,165	40,106	17,714	35,270	151,437	173,987

2. Catchment inflow

Catchment inflow is the balancing item in this water balance. It is the difference between the total outflows, and the known inflows and the net change in storage volume.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-47 lists the wastewater treatment plants in the Loddon basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-47 Volume and use of recycled water in the Loddon basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Bendigo	6,129	1,721	28%	1,246	475	0	0	4,408	0
Boort	0	0	0%	0	0	0	0	0	0
Bridgewater / Inglewood	0	0	0%	0	0	0	0	0	0
Castlemaine	1,257	21	2%	21	0	0	0	1,237	0
Clunes	6	6	100%	0	6	0	0	0	0
Daylesford	312	312	100%	12	300	0	0	0	0
Dunolly	14	14	100%	0	14	0	0	0	0
Kerang	600	0	0%	0	0	0	0	0	600
Maryborough	427	427	100%	19	408	0	0	0	0
Pyramid Hill	0	0	0%	0	0	0	0	0	0
Waubra	4	4	100%	0	4	0	0	0	0
Wedderburn	25	25	100%	0	25	0	0	0	0
Total 2017–18	**8,774**	**2,530**	**40%**	**1,298**	**1,232**	**0**	**0**	**5,645**	**600**
Total 2016–17	9,135	1,672	18%	812	860	0	0	6,405	1,056

4. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-48 provides information about small catchment dams in the basin.

New hydrological modelling has provided a more-accurate measure of usage and harvested volumes for the 2017–18 reporting period. Therefore, the volumes for small catchment dams in 2016–17 are not directly comparable with the volumes reported for 2017–18. Each year presents the best estimate of the water harvested, used and lost, based on the best information that was available at the time. For more information, see Appendix E and chapter 6.1.2.

Table 6-48 Estimated small catchment dam information for the Loddon basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	42,917	4,986	5,619	10,605
Registered/licensed commercial and irrigation	16,726	2,489	1,005	3,494
Total 2017–18	**59,642**	**7,475**	**6,624**	**14,099**
Total 2016–17	66,617	39,361	33,918	73,279

5. In-stream losses

The method used to estimate in-stream loss in the Loddon basin in the 2017–18 accounts has been revised from previous accounts, as chapter 6.1.2 explains. This has increased the losses in the basin as additional losses downstream of Loddon Weir are now being accounted for in 2017–18: the previous method would have estimated the in-stream loss to be 17,582 ML, rather than 20,536 ML.

6.8.4 Compliance against entitlements

Compliance against water entitlements is reported in these accounts in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Loddon – Key compliance points

- ✓ **There was no net increase to the total entitlement volume from the previous year.**
- ✓ **The total volume diverted (52,635 ML) was within the volume available for the year (65,688 ML).**
- ✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
- ✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the Loddon basin provide the basis for how water is shared in the basin. Rights to water in the Loddon basin are outlined in Table 6-49.

Entitlements to water in regulated systems in the Loddon basin provide for the right to carry over unused allocation to the next season. In the Loddon basin, these entitlement holders can carry over unused water up to 50% of their entitlement volume. Any unused water above this amount is written off.

Diversions under bulk entitlements are assessed against the Murray–Darling basin annual cap target for the Goulburn–Broken–Loddon Valley. Since 2012, cap compliance has been reported to the MDBA through the *Transition Period Water Take Report* (refer to the MDBA's website > Publications). Before this, details of this assessment were published annually in the MDBA's *Water Audit Monitoring Report.*

Table 6-49 Entitlement volumes in the Loddon basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Loddon System – Goulburn-Murray Water) Conversion Order 2005 (1)	
High-reliability water shares – Loddon	21,391
Low-reliability water shares – Loddon	8,079
Bulk Entitlement (Loddon River – Environmental Reserve) Order 2005 (2)	
Loddon wetland entitlement	2,000
Loddon system – East Loddon Waterworks District modernisation savings entitlement	1,480
Loddon system – Wimmera Mallee Pipeline savings entitlement (3)	7,490
Loddon environmental low-reliability entitlement	2,024
Subtotal: Bulk Entitlement (Loddon River – Environmental Reserve) Order 2005	**12,994**
Bulk Entitlement (Loddon System – Part Maryborough – Central Highlands Water) Conversion Order 2005	1,200
Bulk Entitlement (Loddon System – Coliban Water) Conversion Order 2005	820
Goulburn supplement (4)	88,000
Subtotal: Bulk Entitlement (Loddon System – Goulburn-Murray Water) Conversion Order 2005	**132,484**
Bulk Entitlement (Bullarook system – Goulburn-Murray Water) Conversion Order 2009 (5)	
High-reliability water shares – Bullarook	758
Low-reliability water shares – Bullarook	381
Bulk Entitlement (Bullarook System – Central Highlands Water) Conversion Order 2009	500
Environmental Entitlement (Birch Creek – Bullarook System) 2009	100
Subtotal: Bulk Entitlement (Bullarook system – Goulburn-Murray Water) Conversion Order 2009	**1,739**

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Creswick) Conversion Order 2004	500
Bulk Entitlement (Daylesford – Hepburn Springs) Conversion Order 2004	916
Bulk Entitlement (Evansford-Talbot System-Part Maryborough-Central Highlands Water) Conversion Order 2006	3,000
Bulk Entitlement (Lexton) Conversion Order 2004	45
Take and use licences – unregulated surface water	22,129
Total (30 June 2018)	**160,813**
Total (30 June 2017)	**160,870**

Notes

(1) Under this bulk entitlement, Goulburn-Murray Water operates Cairn Curran Reservoir, Tullaroop Reservoir, Laanecoorie Reservoir and Loddon Weir to supply water share holders in the Loddon system and to supply the Loddon system bulk entitlements held by Central Highlands Water, Coliban Water and the VEWH.

(2) 2017–18 is the first year that the components of this entitlement have been reported in the accounts. This detail has been included to provide more clarity about the entitlement, and it does not represent a change in the entitlement.

(3) This entitlement is supplied from the Goulburn system by Goulburn-Murray Water under the *Bulk Entitlement (Eildon – Goulburn Weir) Conversion Order 1995*. The volume is also included in the Goulburn basin as a component of the Eildon – Goulburn Weir bulk entitlement.

(4) The Loddon system – Goulburn-Murray Water bulk entitlement specifies that after ensuring all Loddon system high-reliability entitlements can be satisfied in the current year and are provided for in the following year, supplies from the Loddon system can be used to supplement the Goulburn system.

(5) Under this bulk entitlement, Goulburn-Murray Water operates Newlyn Reservoir and Hepburns Lagoon to supply water share holders in the Bullarook system and to supply the Bullarook system bulk entitlements held by Central Highlands Water and the VEWH.

Table 6-50 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-50 Available water and take for the Loddon basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Loddon system – Goulburn-Murray Water					
Water shares – Loddon	5,399	17,886	(8,619)	**14,666**	**9,187**
Loddon River – Environmental Reserve [1]	2,703	10,267	7,153	**20,123**	**16,876**
Loddon system – Part Maryborough – Central Highlands Water	892	1,200	(300)	**1,792**	**827**
Loddon system – Coliban Water	266	554	(250)	**570**	**397**
Goulburn supplement [2]	-	-	-	**-**	**8,554**
Operating provisions (whole of system) [3]	-	-	-	**-**	**6,458**
Diversion: Loddon system – Goulburn-Murray Water [4]					**42,299**
Bullarook system – Goulburn-Murray Water					
Water shares – Bullarook	349	790	39	**1,178**	**909**
Bullarook system – Central Highlands Water	238	263	(39)	**461**	**204**
Environmental entitlement Birch Creek – Bullarook system [5]	100	100	0	**200**	**0**
Diversion: Bullarook system – Goulburn-Murray Water [6]					**1,113**
Creswick	-	500	0	**500**	**500**
Daylesford – Hepburn Springs	-	916	0	**916**	**650**
Evansford-Talbot system – part Maryborough-Central Highlands Water	-	3,000	0	**3,000**	**1,541**
Lexton	-	45	0	**45**	**0**
Take and use licences – unregulated surface water	-	22,275	(37)	**22,238**	**5,403**
Total 2017–18	**9,946**	**57,795**	**(2,053)**	**65,688**	**52,635**
Total 2016–17	9,754	59,436	(9,239)	59,951	43,422

Notes

(1) The water taken under this entitlement reported here reflects the volume of water delivered under the components of the entitlement listed in Table 6-49. Passing flows and river freshening flows were also delivered under this entitlement, and they are not included in this table (303 ML and 828 ML respectively). The volume of water delivered in-stream (13,829 ML) is not included in the calculation of total diversion for the Loddon system – Goulburn-Murray Water bulk entitlement. 3047 ML of the volume was diverted off-stream.

(2) The Loddon supplement supplies water to the Goulburn system, providing for entitlement holders with Goulburn water shares. As such, the volume is reported as a transfer to the Goulburn basin.

(3) This reflects use of water to manage the Loddon system. It equals the amount diverted to Serpentine Creek and not used by customers.

(4) The water use reported in this line item represents the bulk diversion to supply primary entitlements and fulfil other operating requirements under the Loddon system source bulk entitlement. It includes environment deliveries in-stream (16,876 ML).

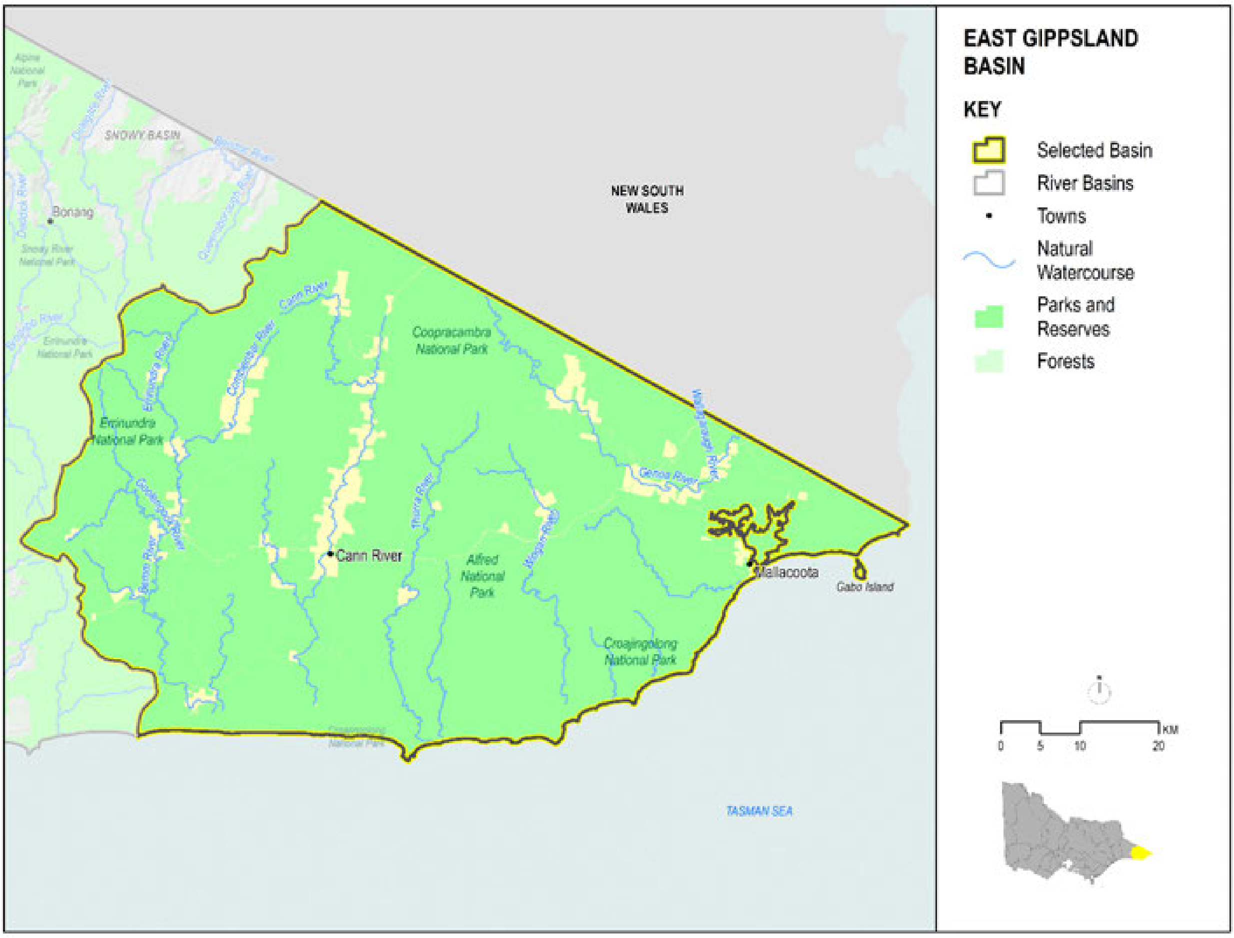
(5) Allocation is only made to this entitlement when high-reliability water shares are greater than 20% in the Bullarook system at the start of December.

(6) The water taken reported in this line item represents the bulk diversion to supply primary entitlements under the Bullarook system source bulk entitlement.

6.9 East Gippsland basin

The East Gippsland basin (Figure 6-15) is the easternmost basin in Victoria. The headwaters of the Genoa River originate in New South Wales and flow through Victoria before reaching the ocean near Mallacoota. Other rivers in the basin include the Betka, Wingan, Thurra, Cann and Bemm rivers.

Figure 6-15 Map of the East Gippsland basin



6.9.1 Management arrangements

Management of water in the East Gippsland basin is undertaken by various parties, the responsibilities of which Table 6-51 shows.

Table 6-51 Responsibilities for water resources management in the East Gippsland basin

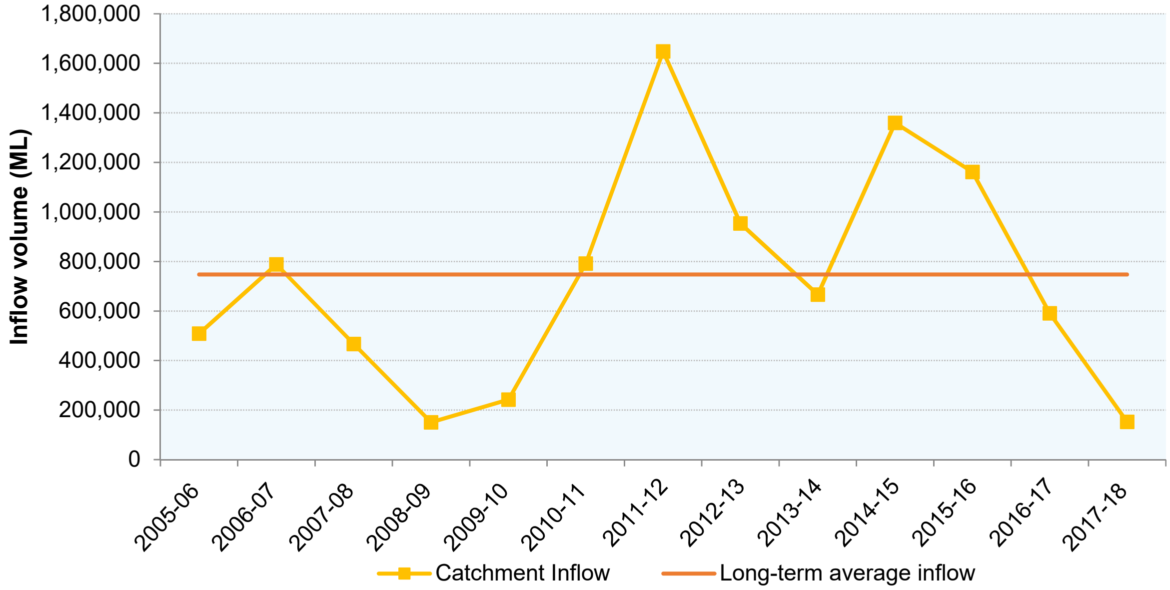
Authority	Management responsibilities
Southern Rural Water	• Manages licensed diversions
East Gippsland Water	• Supplies urban water to towns including Mallacoota, Cann River and Bemm River
East Gippsland Catchment Management Authority	• Responsible for waterway and catchment management in the entire East Gippsland basin

6.9.2 2017–18 Water resource overview

In 2017–18, rainfall in the East Gippsland basin was between 60% and 80% of the long-term average.

The long-term average used in the 2017–18 accounts has been revised from previous accounts and is now an average of post-1975 streamflow, as chapter 2.2 explains. Catchment inflows were 20% of the long-term annual average of 747,262 ML: much less than the inflows recorded in 2016–17, which were 79% of the revised long-term average. Consumptive use in the basin is generally very low compared to water availability, and almost 100% of total inflows passed to Bass Strait in 2017–18.

Figure 6-16 Catchment inflows in the East Gippsland basin



The only restrictions placed on licensed diversions in East Gippsland basin during 2017–18 were during the months of April and May 2018, with a ban implemented for the upstream section of the Cann River East Branch.

There were no urban water-use restrictions applied in the East Gippsland basin in 2017–18, with all towns on permanent water-saving rules throughout the year.

In 2017–18, 529 ML of water was diverted for consumptive purposes (town, domestic and stock, irrigation and commercial supply). This was less than the 929 ML diverted in the previous year. A large portion (711 ML) of last year's diversion was the reporting of small catchment dam use, which has reduced this year to 362 ML, due to improved hydrological modelling. For more information, see Appendix E.

Water for the environment

Environmental assets that rely on water in the East Gippsland basin include:

- the Bemm, Cann and Genoa rivers, which all feed into high-value wetlands
- Sydenham, Tamboon and Mallacoota inlets (all nationally significant wetlands)
- pristine estuaries, heritage river reaches and the swamp skink, Australian grayling, Australian bass, tangle orchid and eastern curlew.

In 2017–18, water for the environment in the East Gippsland basin comprised:

- water set aside for the environment through flow-sharing arrangements set out in bulk entitlements held by East Gippsland Water
- water set aside for the environment through the operation of passing flow conditions on licensed diversions
- all other water in the basin not allocated for consumptive use: this water also provides social, recreational and cultural benefits.

6.9.3 Water balance

The total volumes of water available and supplied from water resources in the East Gippsland basin in 2017–18 are shown in Table 6-52.

Table 6-52 Water balance – East Gippsland basin

Water account component	Note	2017–18 (ML)	2016–17 (ML)
Major on-stream storage			
Volume in storage at start of year	1	-	-
Volume in storage at end of year	1	-	-
Change in storage		**-**	**-**
Inflows			
Catchment inflow	2	152,362	590,897
Rainfall on major storages	1	-	-
Treated wastewater discharged back to river	3	0	0
Total inflows		**152,362**	**590,897**
Outflows			
Diversions			
Urban diversions		118	124
Licensed diversions from unregulated streams		49	95
Small catchment dams	4	362	711
Total diversions		***529***	***929***
Losses			
Evaporation losses from major storages	1	-	-
Evaporation from small catchment dams	4	237	227
In-stream infiltration to groundwater, flows to floodplain and evaporation	5	n/a	n/a
Total losses		***237***	***227***
Water passed at outlet of basin			
River outflows to the ocean		151,596	589,741
Total water passed at outlet of basin		***151,596***	***589,741***
Total outflows		**152,362**	**590,897**

Note
n/a Not applicable.

Notes to the water balance

1. Storages

There are no major storages located within the East Gippsland basin.

2. Catchment inflow

Catchment inflow is the balancing item in this water balance. It is the difference between the total outflows and the known inflows.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-53 lists the wastewater treatment plants in the East Gippsland basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-53 Volume and use of recycled water in the East Gippsland basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Bemm River	7	7	100%	0	7	0	0	0	0
Cann River	16	16	100%	0	16	0	0	0	0
Mallacoota	50	50	100%	0	50	0	0	0	0
Total 2017–18	**73**	**73**	**100%**	**0**	**73**	**0**	**0**	**0**	**0**
Total 2016–17	130	130	100%	0	130	0	0	0	0

4. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-54 provides information about small catchment dams in the basin.

New hydrological modelling has provided a more-accurate measure of usage and harvested volumes for the 2017–18 reporting period. Therefore, the volumes for small catchment dams in 2016–17 are not directly comparable with the volumes reported for 2017–18. Each year presents the best estimate of the water harvested, used and lost, based on the best information that was available at the time. For more information, see Appendix E and chapter 6.1.2.

Table 6-54 Estimated small catchment dam information for the East Gippsland basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	1,094	310	220	530
Registered/licensed commercial and irrigation	176	52	17	69
Total 2017–18	**1,271**	**362**	**237**	**599**
Total 2016–17	1,302	711	226	937

5. In-stream losses

An assessment of in-stream infiltration to groundwater, flows to floodplain and evaporation is not made in the East Gippsland basin as no suitable models are available and the distribution of streamflow gauges across the basin makes it difficult to estimate in-stream losses (see chapter 6.1.2).

6.9.4 Compliance against entitlements

Compliance against water entitlements is reported in these accounts in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

East Gippsland – Key compliance points
✓ **There was no net increase to the total entitlement volume from the previous year.**
✓ **The total volume diverted (167 ML) was within the volume available for the year (1,281 ML).**
✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the East Gippsland basin provide the basis for how water is shared in the basin. Rights to water in the East Gippsland basin are outlined in Table 6-55.

Table 6-55 Entitlement volumes in the East Gippsland basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Bemm River) Conversion Order 1997	100
Bulk Entitlement (Cann River) Conversion Order 1997	192
Bulk Entitlement (Mallacoota) Conversion Order 1997	330
Take and use licences – unregulated surface water	657
Total (30 June 2018)	**1,279**
Total (30 June 2017)	**1,281**

Table 6-56 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

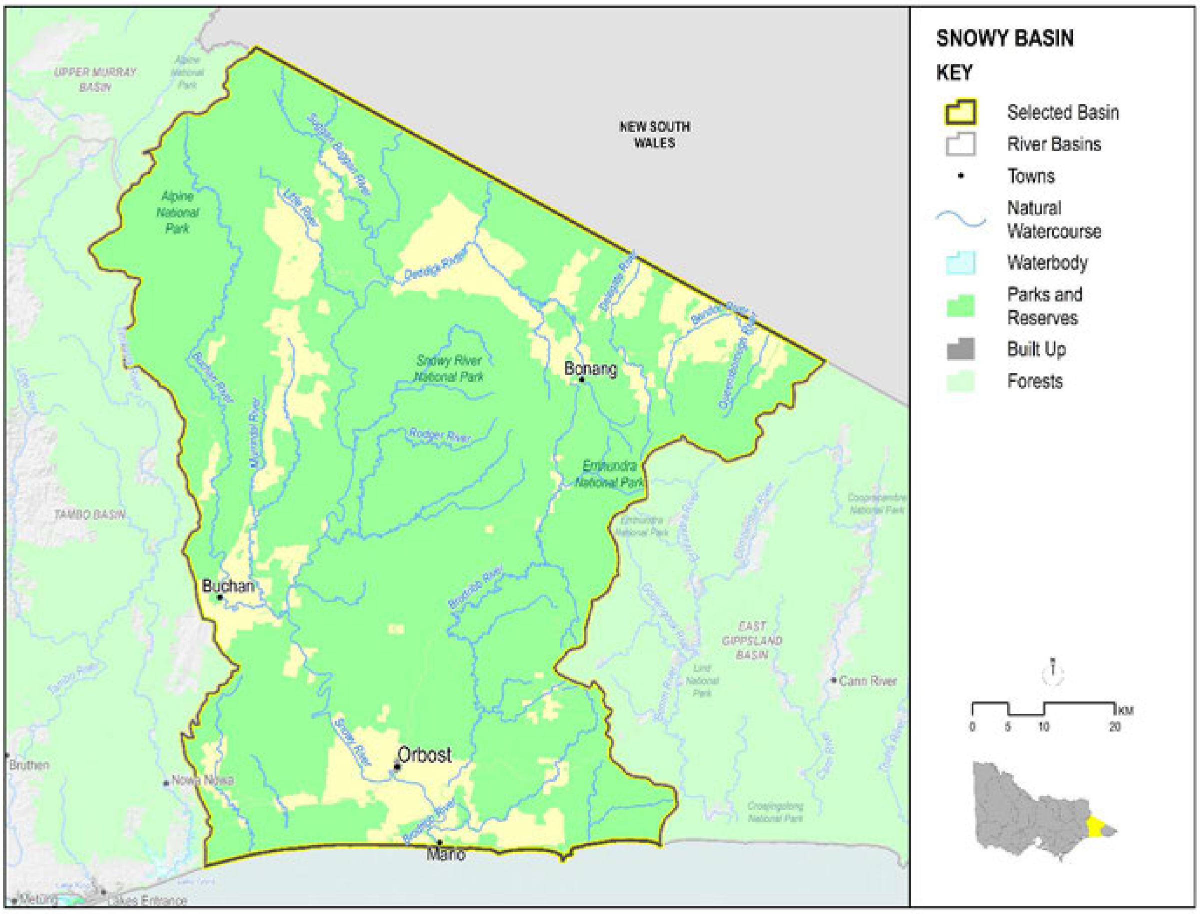
Table 6-56 Available water and take for the East Gippsland basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Bemm River	-	100	0	**100**	**15**
Cann River	-	192	0	**192**	**42**
Mallacoota	-	330	0	**330**	**61**
Take and use licences – unregulated surface water	-	659	0	**659**	**49**
Total 2017–18	**-**	**1,281**	**0**	**1,281**	**167**
Total 2016–17	-	1,281	0	1,281	219

6.10 Snowy basin

Victoria's Snowy basin (Figure 6-17) is located in east Gippsland. The Snowy River originates in New South Wales and is part of the Snowy Mountains Hydro-Electric Scheme, which connects it to the Murray and Murrumbidgee rivers. Major tributaries include the Deddick River, Buchan River and Brodribb River which join the Snowy River before it flows into Bass Strait at Marlo. As these accounts provide a record of water availability and use across Victoria, this chapter only considers the portion of the Snowy basin located in Victoria.

Figure 6-17 Map of the Snowy basin



6.10.1 Management arrangements

Management of water in the Snowy basin is undertaken by various parties, the responsibilities of which Table 6-57 shows. In the New South Wales Snowy basin, Snowy Hydro Limited releases water under a licence issued by that state's Department of Planning, Industry and Environment.

Table 6-57 Responsibilities for water resources management in the Snowy basin

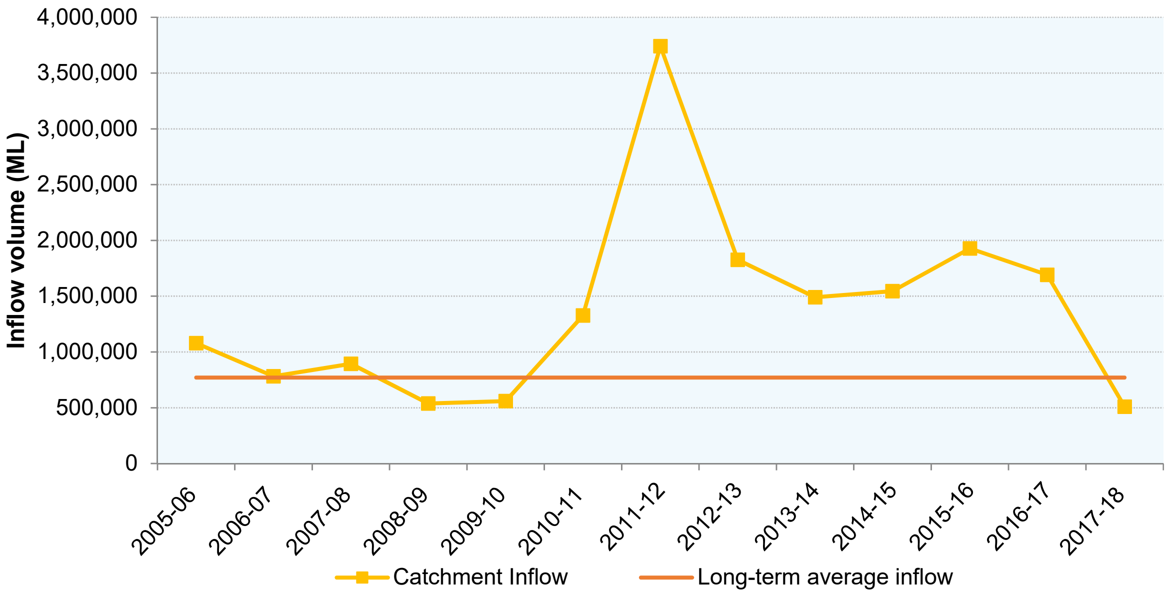
Authority	Management responsibilities
Southern Rural Water	• Manages surface water licensed diversions
East Gippsland Water	• Supplies towns including Buchan, Orbost and Marlo
East Gippsland Catchment Management Authority	• Responsible for waterway and catchment management in the whole of the Snowy basin

6.10.2 2017–18 Water resource overview

In 2017–18, the majority of the Snowy basin received between 60% and 80% of long-term average rainfall, except for the north-west of the basin which received between 80% to 100%, and the south-west corner which received between 40% to 60% of the long-term average.

The long-term average used in the 2017–18 accounts has been revised from previous accounts and is now an average of post-1975 streamflow, as chapter 2.2 explains. Catchment inflows to the Victorian Snowy basin were below-average in 2017–18 (66% of the revised long-term average of 770,741 ML), much lower than the inflows recorded in 2016–17, which were 218% of the revised long-term average.

Figure 6-18 Catchment inflows in the Snowy basin



The Jarrahmond section of the Snowy River remained unrestricted for the entirety of 2017–18. The Buchan River remained unrestricted from July 2017 through to January 2018, with stage 1 restrictions implemented in February, progressing to a ban on all licensed diversions in May 2018, which were then lifted in June 2018.

There were no urban water-use restrictions applied in the Snowy basin in 2017–18, with all towns on permanent water-saving rules throughout the year.

In 2017–18, 2,684 ML of water was diverted for consumptive purposes (town, domestic and stock, irrigation and commercial supply). This was less than the 3,964 ML diverted in the previous year. Some of the change from the previous year's diversion is related to the reporting of small catchment dam use, which reduced from 2,811 ML last year to only 1,092 ML this year, due to improved hydrological modelling. For more information, see Appendix E.

Water for the environment

The health of the Snowy River depends on water. Environmental assets include:

- Australian grayling populations, heritage river reaches, the Ewings Marsh wetlands complex and the Snowy River daisy
- freshwater species (such as river blackfish and Australian grayling) found in the upper reaches and tributaries of the Snowy River
- the lower reaches of the Snowy River, which support species including estuary perch and Australian bass that move between saltwater and freshwater systems
- estuarine and saltwater species (such as flathead, mulloway and black bream) contained in the estuary
- the nationally important floodplain wetlands of the Snowy River near Marlo, which provide feeding and breeding areas for wetland and migratory birds.

In 2017–18, water for the environment in the Snowy basin comprised:

- water set aside for the environment through the operation of passing flows released as a condition of the water licence issued to Snowy Hydro
- water recovered for the environment as part of the Snowy Water Inquiry and released by Snowy Hydro in accordance with conditions of the water licence
- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements held by East Gippsland Water
- water set aside for the environment through the operation of passing flow conditions on licensed diversions
- all other water in the basin not allocated for consumptive use: this water also provides social, recreational and cultural benefits.

6.10.3 Water balance

The total volumes of water available and supplied from water resources in the Snowy basin in 2017–18 are shown in Table 6-58. As these accounts provide a record of water availability and use across Victoria, this balance only considers the Victorian portion of the Snowy basin.

Table 6-58 Water balance – Snowy basin

Water account component	Note	2017–18 (ML)	2016–17 (ML)
Major on-stream storage			
Volume in storage at start of year	1	-	-
Volume in storage at end of year	1	-	-
Change in storage		**-**	**-**
Inflows			
Catchment inflow from Victoria	2	509,900	1,691,959
Catchment inflow from New South Wales	2	248,869	409,320
Rainfall on major storages	1	-	-
Treated effluent discharged back to river	3	0	0
Total inflows		**758,769**	**2,101,279**
Outflows			
Diversions			
Urban diversions		723	680
Licensed diversions from unregulated streams		869	473
Small catchment dams	4	1,092	2,811
Total diversions		***2,684***	***3,964***
Losses			
Evaporation losses from major storages	1	-	-
Evaporation from small catchment dams	4	1,154	685
In-stream infiltration to groundwater, flows to floodplain and evaporation	5	n/a	n/a
Total losses		***1,154***	***685***
Water passed at outlet of basin			
River outflows to the ocean		754,931	2,096,630
Total water passed at outlet of basin		***754,931***	***2,096,630***
Total outflows		**758,769**	**2,101,279**

Note
n/a Not applicable.

Notes to the water balance

1. Storages

There are no major storages located within the Victorian portion of the Snowy basin.

2. Catchment inflow

Catchment inflow from Victoria is the balancing item in this water balance. It is the difference between the total outflows and the known inflows.

Catchment inflow from New South Wales is recorded as the volume flowing from the Snowy River at Burnt Hut Crossing (gauge 222013).

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-59 lists the wastewater treatment plants in the Snowy basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-59 Volume and use of recycled water in the Snowy basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Orbost	161	161	100%	0	161	0	0	0	0
Total 2017–18	**161**	**161**	**100%**	**0**	**161**	**0**	**0**	**0**	**0**
Total 2016–17	237	237	100%	0	237	0	0	0	0

4. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-60 provides information about small catchment dams in the basin.

New hydrological modelling has provided a more-accurate measure of usage and harvested volumes for the 2017–18 reporting period. Therefore, the volumes for small catchment dams in 2016–17 are not directly comparable with the volumes reported for 2017–18. Each year presents the best estimate of the water harvested, used and lost, based on the best information that was available at the time. For more information, see Appendix E and chapter 6.1.2.

Table 6-60 Estimated small catchment dam information for the Snowy basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	2,840	727	997	1,725
Registered/licensed commercial and irrigation	1,590	364	156	521
Total 2017–18	**4,430**	**1,092**	**1,154**	**2,245**
Total 2016–17	4,540	2,811	685	3,496

5. In-stream losses

An assessment of in-stream infiltration to groundwater, flows to floodplain and evaporation is not made in the Snowy basin as there are no suitable models available, and the distribution of streamflow gauges across the basin makes it difficult to estimate in-stream losses (see chapter 6.1.2).

6.10.4 Compliance against entitlements

Compliance against water entitlements is reported in these accounts in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Snowy – Key compliance points

- ✓ **There was no net increase to the total entitlement volume from the previous year.**
- ✓ **The total volume diverted (1,592 ML) was within the volume available for the year (6,159 ML).**
- ✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
- ✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the Snowy basin provide the basis for how water is shared in the basin. Rights to water in the Snowy basin are outlined in Table 6-61.

Table 6-61 Entitlement volumes in the Snowy basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Buchan) Conversion Order 1997	170
Bulk Entitlement (Orbost System) Conversion Order 1997	2,031
Take and use licences – unregulated surface water	3,949
Total (30 June 2018)	**6,150**
Total (30 June 2017)	**6,159**

Table 6-62 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

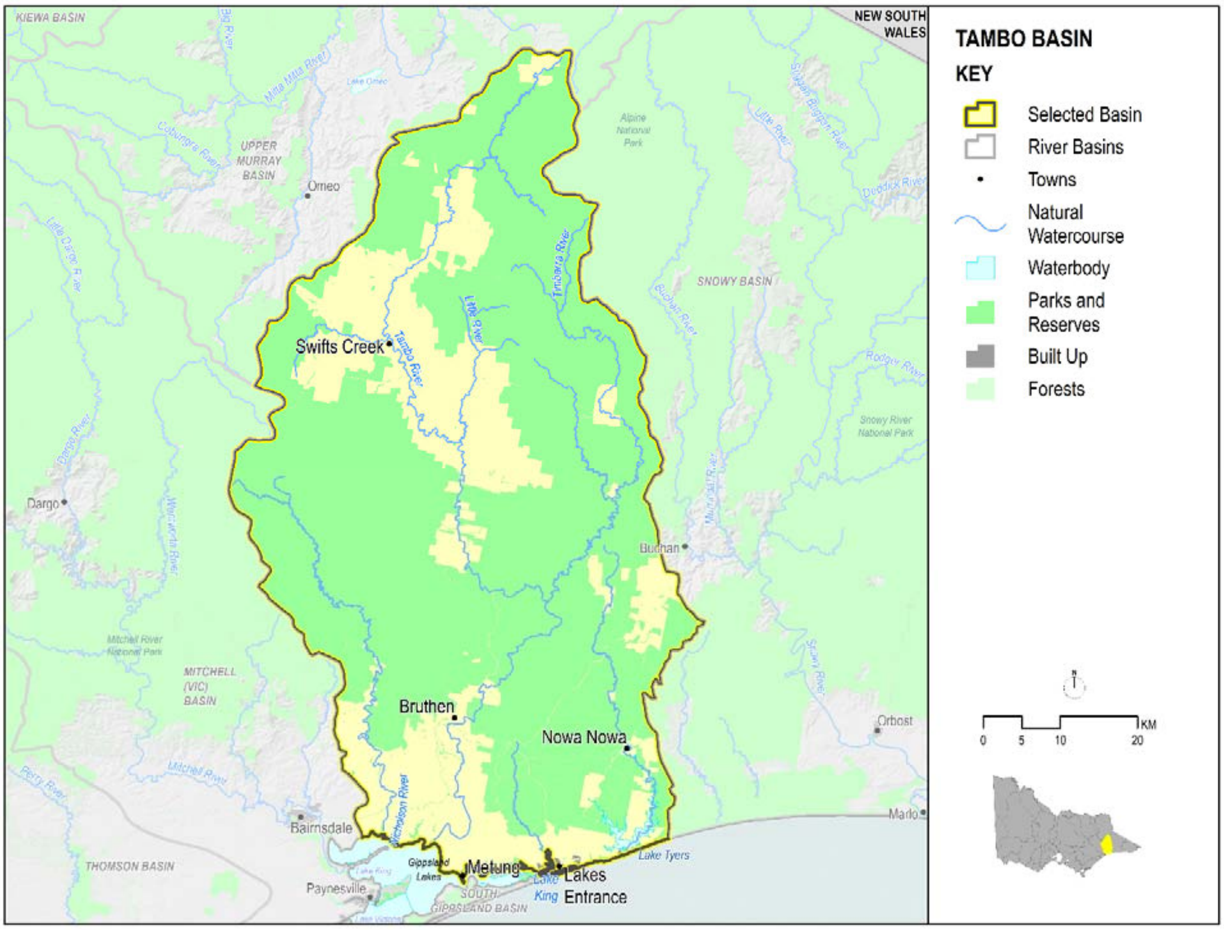
Table 6-62 Available water and take for the Snowy basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Buchan	-	170	0	**170**	**23**
Orbost system	-	2,031	0	**2,031**	**701**
Take and use licences – unregulated surface water	-	3,958	0	**3,958**	**869**
Total 2017–18	**-**	**6,159**	**0**	**6,159**	**1,592**
Total 2016–17	-	6,163	0	6,163	1,153

6.11 Tambo basin

The Tambo basin (Figure 6-19) is located in south-east Victoria. The basin contains the Tambo River and the Nicholson River, which flow into the Gippsland Lakes.

Figure 6-19 Map of the Tambo basin



6.11.1 Management arrangements

Management of water in the Tambo basin is undertaken by various parties, the responsibilities of which Table 6-63 shows.

Table 6-63 Responsibilities for water resources management in the Tambo basin

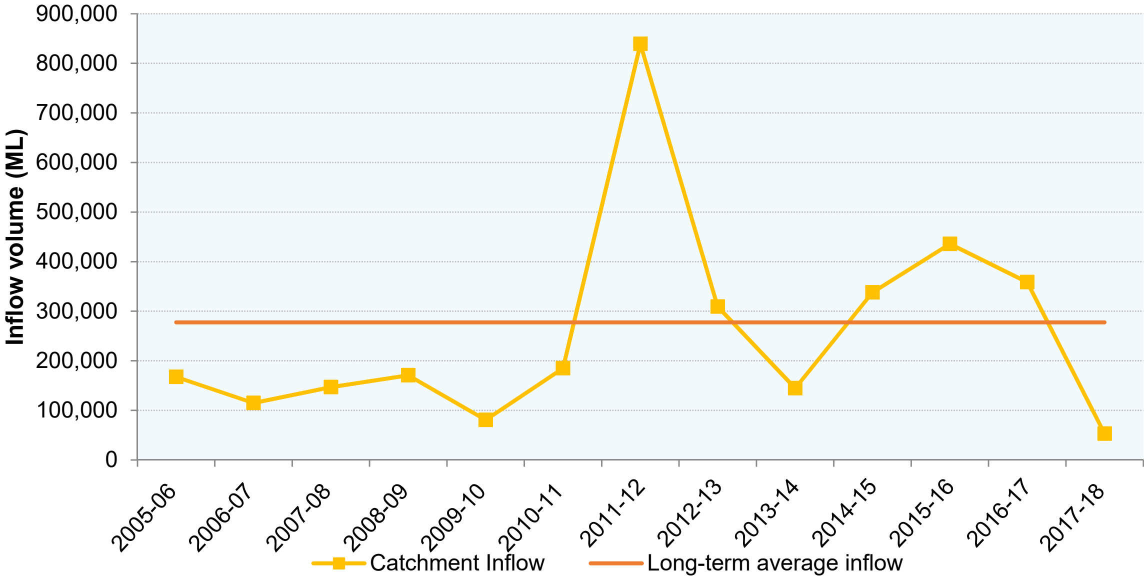
Authority	Management responsibilities
Southern Rural Water	• Manages licensed diversions
East Gippsland Water	• Supplies Swifts Creek; towns including Lakes Entrance, Bruthen and Nowa Nowa are supplied from neighbouring basins
East Gippsland Catchment Management Authority	• Responsible for waterway and catchment management in the whole of the Tambo basin

6.11.2 2017–18 Water resource overview

In 2017–18, rainfall in the south of the Tambo basin was between 60% and 80% of the long-term average, and rainfall in the north was between 80% and 100%.

The long-term average used in the 2017–18 accounts has been revised from previous accounts and is now an average of post-1975 streamflow, as chapter 2.2 explains. Catchment inflows in 2017–18 were 19% of the revised long-term average annual volume of 277,658 ML, much lower than the inflows recorded in 2016–17, which were 129% of the revised long-term average. There are no large, authorised diversions in the Tambo basin. Larger towns (such as Lakes Entrance and Bruthen) are supplied by the Bairnsdale water system (sourcing water from the Mitchell basin). Therefore, about 95% of the basin inflows passed through to the Gippsland Lakes in 2017–18.

Figure 6-20 Catchment inflows in the Tambo basin



There were no restrictions on licensed diversions from unregulated streams in the Tambo basin from July 2017 to January 2018. Restrictions were placed on the Tambo River from February and were lifted in early May. The Tambo River downstream of Ramrod Creek had a stage 1 roster in place from March to May 2018. There were no urban water-use restrictions applied in the Tambo basin in 2017–18, and all towns were on permanent water-saving rules throughout the year.

In 2017–18, 1,572 ML of water was diverted for consumptive purposes (town, domestic and stock, irrigation and commercial supply). This was less than the 3,930 ML diverted in the previous year. The vast majority (3,661 ML) of last years' diversion was the reporting of small catchment dam use, which has reduced this year to 912 ML ,due to improved hydrological modelling. For more information, see Appendix E.

Water for the environment

The Gippsland Lakes are important environmental assets partially dependent on water in the Tambo basin. They are listed as internationally significant wetlands under the Ramsar Convention and rely on the freshwater inputs from the Tambo basin to function ecologically. Other environmental assets that rely on water for the environment include fish populations (Australian grayling, black bream) and the Tambo and Nicholson rivers.

The Tambo River has an extensive estuary extending from The Cliffs (upstream of the town of Swan Reach) to the Gippsland Lakes at Lake King. Significant wetlands along the estuary reach of the river include the East Swamps (south of Sardine Flat Road), Lake King Wetlands and Russells Swamp.

The Nicholson River has an extensive estuary reach that extends from the Great Alpine Road bridge at Sarsfield to where the river enters the Gippsland Lakes at Jones Bay. There are several important wetlands on both sides of the river, the largest being Bosses Swamp and Nebbor Swamp.

In 2017–18, water for the environment in the Tambo basin comprised:

- water set aside for the environment through the operation of passing flow conditions on licensed diversions and consumptive bulk entitlements held by East Gippsland Water
- all other water in the basin not allocated for consumptive use: this water also provides social, recreational and cultural benefits.

6.11.3 Water balance

The total volumes of water available and supplied from water resources in the Tambo basin in 2017–18 are shown in Table 6-64.

Table 6-64 Water balance – Tambo basin

Water account component	Note	2017–18 (ML)	2016–17 (ML)
Major on-stream storage			
Volume in storage at start of year	1	-	-
Volume in storage at end of year	1	-	-
Change in storage		**-**	**-**
Inflows			
Catchment inflow	2	52,891	358,443
Rainfall on major storages	1	-	-
Treated wastewater discharged back to river	3	0	0
Total inflows		**52,891**	**358,443**
Outflows			
Diversions			
Urban diversions		28	24
Licensed diversions from unregulated streams		633	245
Small catchment dams	4	912	3,661
Total diversions		***1,572***	***3,930***
Losses			
Evaporation losses from major storages	1		-
Evaporation from small catchment dams	4	1,090	2,179
In-stream infiltration to groundwater, flows to floodplain and evaporation	5	n/a	n/a
Total losses		***1,090***	***2,179***
Water passed at outlet of basin			
River outflows to the ocean		50,229	352,334
Total water passed at outlet of basin		***50,229***	***352,334***
Total outflows		**52,891**	**358,443**

Note
n/a Not applicable.

Notes to the water balance

1. Storages

No storage information is recorded in the water balance as there are no major on-stream storages in the Tambo basin.

2. Catchment inflow

Catchment inflow is the balancing item in this water balance. It is the difference between the total outflows and the known inflows.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-65 lists the wastewater treatment plants in the Tambo basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance. In 2017–18, 100% of wastewater passing through treatment plants in the Tambo basin was recycled and used for agricultural applications including pasture, tree plantations, racecourses and golf courses.

Table 6-65 Volume and use of recycled water in the Tambo basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Lakes Entrance	736	736	100%	0	736	0	0	0	0
Metung	126	126	100%	0	126	0	0	0	0
Total 2017–18	**862**	**862**	**100%**	**0**	**862**	**0**	**0**	**0**	**0**
Total 2016–17	882	882	100%	0	882	0	0	0	0

4. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-66 provides information about small catchment dams in the basin.

New hydrological modelling has provided a more-accurate measure of usage and harvested volumes for the 2017–18 reporting period. Therefore, the volumes for small catchment dams in 2016–17 are not directly comparable with the volumes reported for 2017–18. Each year presents the best estimate of the water harvested, used and lost, based on the best information that was available at the time. For more information, see Appendix E and chapter 6.1.2.

Table 6-66 Estimated small catchment dam information for the Tambo basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	4,933	749	1,013	1,762
Registered/licensed commercial and irrigation	1,357	163	77	240
Total 2017–18	**6,289**	**912**	**1,090**	**2,002**
Total 2016–17	6,418	3,661	2,179	5,840

5. In-stream losses

An assessment of in-stream infiltration to groundwater, flows to floodplain and evaporation is not made in the Tambo basin as there are no suitable models and the distribution of streamflow gauges across the basin makes it difficult to estimate in-stream losses (see chapter 6.1.2).

6.11.4 Compliance against entitlements

Compliance against water entitlements is reported in these accounts in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Tambo – Key compliance points

- ✓ **There was a net increase in entitlement volume of 32 ML, due to the issue of a new take and use licence in the area.**
- ✓ **The total volume diverted (660 ML) was within the volume available for the year (4,495 ML).**
- ✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
- ✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the Tambo basin provide the basis for how water is shared in the basin. Rights to water in the Tambo basin are outlined in Table 6-67.

Table 6-67 Entitlement volumes in the Tambo basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Nowa Nowa) Conversion Order 1997	118
Bulk Entitlement (Swifts Creek) Conversion Order 1997	224
Take and use licences – unregulated surface water	4,151
Total (30 June 2018)	**4,493**
Total (30 June 2017)	**4,461**

Table 6-68 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-68 Available water and take for the Tambo basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Nowa Nowa (1)	-	118	0	**118**	**0**
Swifts Creek	-	224	0	**224**	**28**
Take and use licences – unregulated surface water	-	4,153	0	**4,153**	**633**
Total 2017–18	**-**	**4,495**	**0**	**4,495**	**660**
Total 2016–17	-	4,492	0	4,492	269

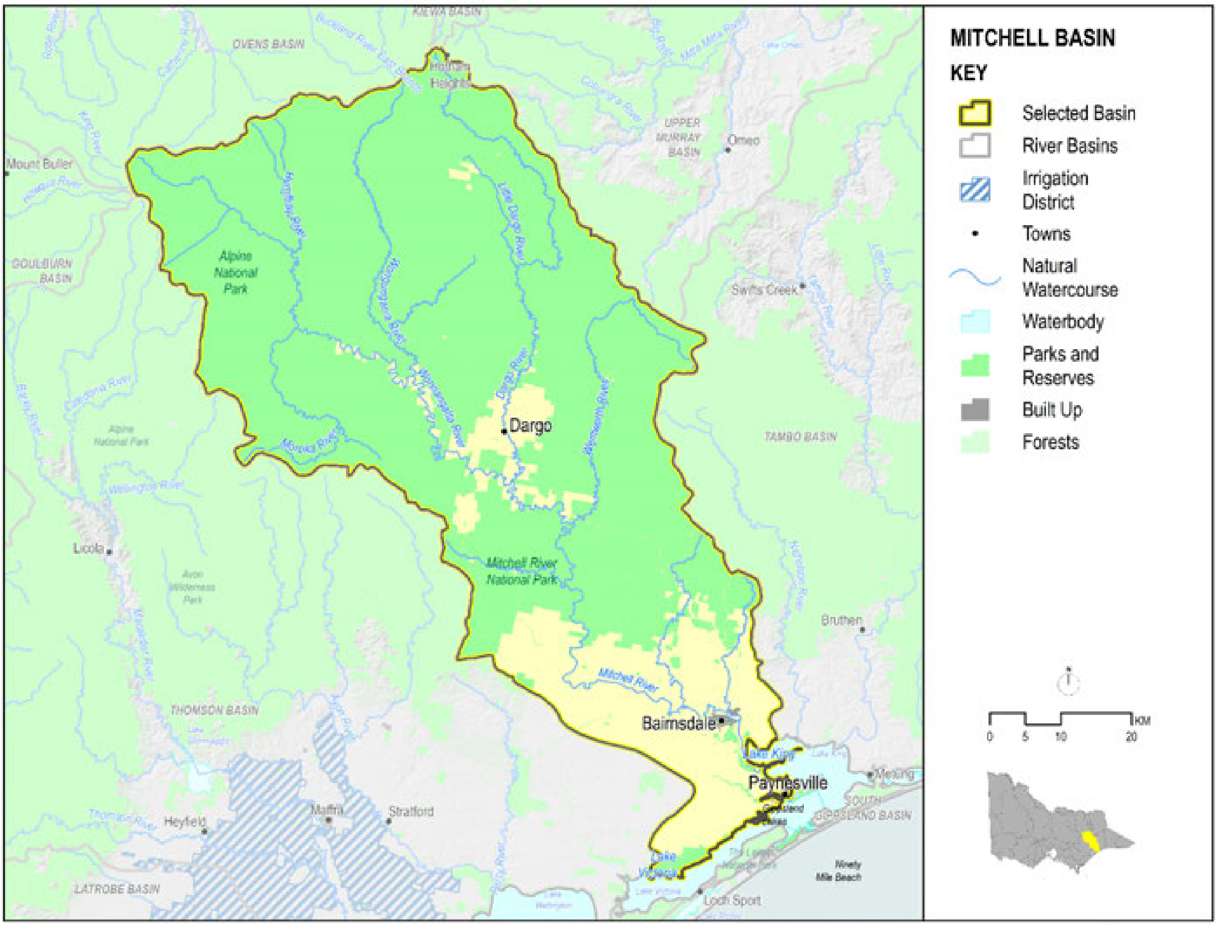
Note

(1) No water was taken under the Nowa Nowa bulk entitlement in 2017–18 as the Nowa Nowa storage has been decommissioned. East Gippsland Water supplied Nowa Nowa under the Bairnsdale bulk entitlement, reported in Table 6-74 in the Mitchell basin.

6.12 Mitchell basin

The Mitchell basin (Figure 6-21) is located in south-east Victoria. The Mitchell River flows into the Gippsland Lakes near Bairnsdale.

Figure 6-21 Map of the Mitchell basin



6.12.1 Management arrangements

Management of water in the Mitchell basin is undertaken by various parties, the responsibilities of which Table 6-69 shows.

Table 6-69 Responsibilities for water resources management in the Mitchell basin

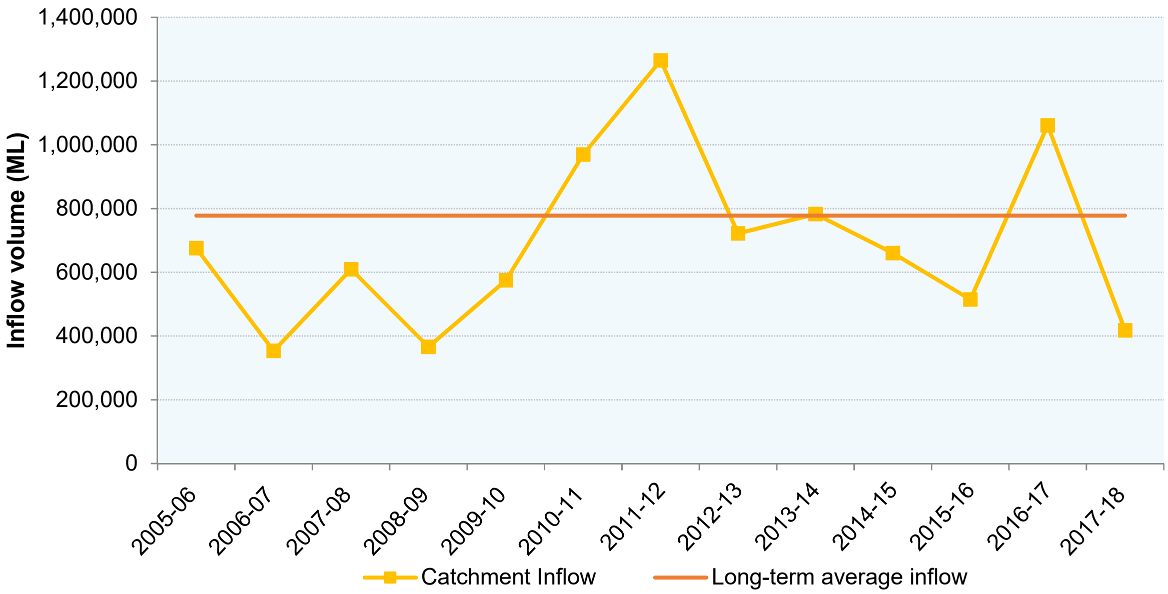
Authority	Management responsibilities
Southern Rural Water	• Manages licensed diversions
East Gippsland Water	• Supplies towns including Bairnsdale, Lakes Entrance and Paynesville
East Gippsland Catchment Management Authority	• Responsible for waterway and catchment management in the Mitchell basin

6.12.2 2017–18 Water resource overview

In 2017–18, between 60% to 80% of the long-term average rainfall was received along the southern border, in the southern half and in a section of the northern half just above Dargo. In the north-west and the north-central areas, rainfall received was between 80% to 100% of the long-term average.

The long-term average used in the 2017–18 accounts has been revised from previous accounts and is now an average of post-1975 streamflow, as chapter 2.2 explains. Catchment inflows in the Mitchell basin were 54% of the revised long-term average of 777,733 ML: less than the inflows recorded in 2016–17, which were 136% of the revised long-term average. Consumptive use in the basin is generally low when compared to the total water resource. About 95% of the total inflows were not diverted and therefore entered the Gippsland Lakes.

Figure 6-22 Catchment inflows in the Mitchell basin



Unregulated streams within the Mitchell basin remained unrestricted for most of 2017–18. A stage 3 roster was in place on the Mitchell River from February 2018 and was then subject to various stages of restrictions from March to May 2018. The Dargo and Wonnangatta rivers were placed on a stage 1 roster in March 2018, with stage 2 restrictions triggered in April 2018. Restrictions for these two rivers reverted to stage 1 in May 2018. All restrictions on all streams were lifted by June 2018.

There were no urban water-use restrictions applied in the Mitchell basin in 2017–18, with all towns on permanent water-saving rules throughout the year.

In 2017–18, 19,181 ML of water was diverted for consumptive purposes (town, domestic and stock, irrigation and commercial supply). This was more than the 19,028 ML diverted in the previous year. About a quarter (4,517 ML) of last years' diversion was the reporting of small catchment dam use, which has reduced this year to 605 ML, due to improved hydrological modelling. For more information, see Appendix E.

Water for the environment

The Gippsland Lakes are important environmental assets which are partially dependent on water in the Mitchell basin. The lakes are listed as internationally significant wetlands under the Ramsar Convention and rely on freshwater inputs from the Mitchell basin to function ecologically.

The Mitchell River has a long estuary reach which extends from the old barrier upstream from Bairnsdale to where the river enters the Gippsland Lakes at Lake King via the internationally significant silt jetties. There are important wetlands on both sides of the river including Macleod Morass, Jones Bay and the Lake King Wetlands at Eagle Point.

Other environmental assets that rely on water include heritage river reaches, fish populations (including Australian grayling and black bream), waterbirds (for example, the great egret) and botanical values (for example, Yellowwood).

In 2017–18, water for the environment in the Mitchell basin comprised:

- water set aside for the environment through the release of passing flows, as a condition of the consumptive bulk entitlement held by East Gippsland Water
- water set aside for the environment through the operation of passing flow conditions on licensed diversions
- all other water in the basin not allocated for consumptive use: this water also provides social, recreational and cultural benefits.

6.12.3 Water balance

The total volumes of water available and supplied from water resources in the Mitchell basin in 2017–18 are shown in Table 6-70.

Table 6-70 Water balance – Mitchell basin

Water account component	Note	2017–18 (ML)	2016–17 (ML)
Major on-stream storage			
Volume in storage at start of year	1	-	-
Volume in storage at end of year	1	-	-
Change in storage		**-**	**-**
Inflows			
Catchment inflow	2	417,895	1,060,803
Rainfall on major storages	1	-	-
Treated wastewater discharged back to river	3	88	209
Total inflows		**417,983**	**1,061,012**
Outflows			
Diversions			
Urban diversions		4,953	4,537
Licensed diversions from unregulated streams		13,623	9,974
Small catchment dams	4	605	4,517
Total diversions		***19,181***	***19,028***
Losses			
Evaporation losses from major storages	1	-	-
Evaporation from small catchment dams	4	686	950
In-stream infiltration to groundwater, flows to floodplain and evaporation	5	1,316	475
Total losses		***2,003***	***1,425***
Water passed at outlet of basin			
River outflows to the Gippsland Lakes		396,799	1,040,558
Total water passed at outlet of basin		***396,799***	***1,040,558***
Total outflows		**417,983**	**1,061,012**

Notes to the water balance

1. Storages

There are no major storages located within the Mitchell basin.

2. Catchment inflow

Catchment inflow is the balancing item in this water balance. It is the difference between the total outflows and the known inflows.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-71 lists the wastewater treatment plants in the Mitchell basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

In addition, 88 ML was returned from the Mount Hotham Alpine Resort to Dargo River during the water year.

Table 6-71 Volume and use of recycled water in the Mitchell basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Bairnsdale	1,169	1,170	100%	0	51	1,119	0	0	(1)
Lindenow	6	6	100%	0	0	6	0	0	0
Paynesville	422	422	100%	0	422	0	0	0	0
Total 2017–18	**1,597**	**1,598**	**100%**	**0**	**473**	**1,125**	**0**	**0**	**(1)**
Total 2016–17	1,709	1,568	92%	0	305	1,263	0	141	0

4. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-72 provides information about small catchment dams in the basin.

New hydrological modelling has provided a more-accurate measure of usage and harvested volumes for the 2017–18 reporting period. Therefore, the volumes for small catchment dams in 2016–17 are not directly comparable with the volumes reported for 2017–18. Each year presents the best estimate of the water harvested, used and lost, based on the best information that was available at the time. For more information, see Appendix E and chapter 6.1.2.

Table 6-72 Estimated small catchment dam information for the Mitchell basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	3,957	388	577	965
Registered/licensed commercial and irrigation	2,912	217	110	327
Total 2017–18	**6,869**	**605**	**686**	**1,291**
Total 2016–17	7,009	4,517	950	5,467

6.12.4 Compliance against entitlements

Compliance against water entitlements is reported in these accounts in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Mitchell – Key compliance points

- ✓ **There was no net increase to the total entitlement volume from the previous year.**
- ✓ **The total volume diverted (18,576 ML) was within the volume available for the year (25,593 ML).**
- ✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
- ✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the Mitchell basin provide the basis for how water is shared in the basin. Rights to water in the Mitchell basin are outlined in Table 6-73.

Table 6-73 Entitlement volumes in the Mitchell basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Bairnsdale) Conversion Order 2000	9,208
Take and use licences – unregulated surface water	16,385
Total (30 June 2018)	**25,593**
Total (30 June 2017)	**25,593**

Table 6-74 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

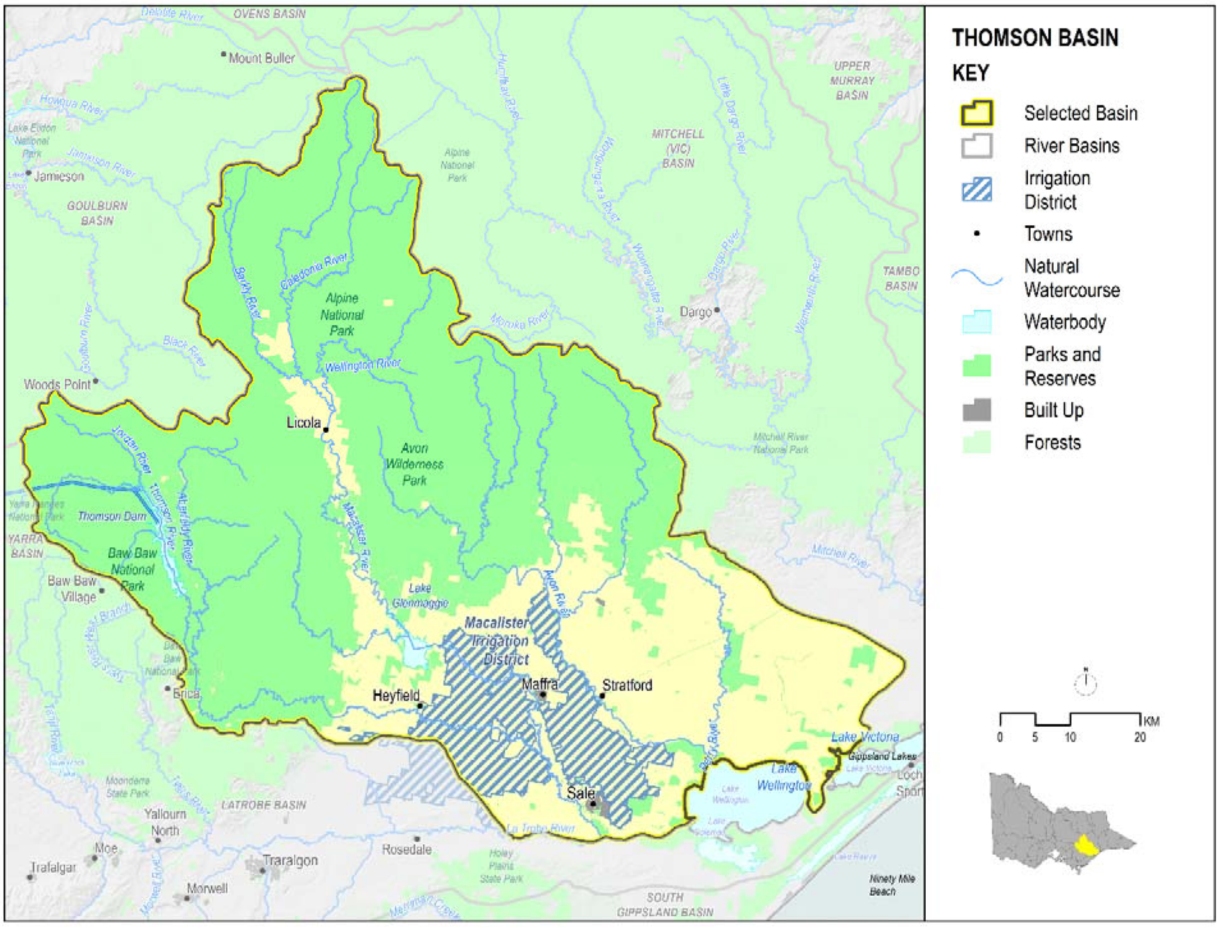
Table 6-74 Available water and take for the Mitchell basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Bairnsdale	-	9,208	0	**9,208**	**4,953**
Take and use licences – unregulated surface water	-	16,385	0	**16,385**	**13,623**
Total 2017–18	**-**	**25,593**	**0**	**25,593**	**18,576**
Total 2016–17	-	25,593	0	25,593	14,511

6.13 Thomson basin

The Thomson basin (Figure 6-23) is located in south-east Victoria. The Thomson and Macalister rivers join the Latrobe River before flowing into the Gippsland Lakes.

Figure 6-23 Map of the Thomson basin



6.13.1 Management arrangements

Management of water in the Thomson basin is undertaken by various parties, the responsibilities of which Table 6-75 shows.

Table 6-75 Responsibilities for water resources management in the Thomson basin

Authority	Management responsibilities
Melbourne Water	• Operates Thomson Reservoir, which supplies water to the Greater Yarra system – Thomson River Pool entitlement holders (Melbourne surface water supply system) and irrigators in the Macalister Irrigation District • Releases water to the Thomson River for environmental flows
Southern Rural Water	• Provides irrigation supplies to the Macalister Irrigation District • Manages groundwater and surface water licensed diversions • Provides bulk water supply to Gippsland Water • Operates Lake Glenmaggie
Gippsland Water	• Supplies towns including Sale, Maffra, Heyfield, Stratford and Boisdale
West Gippsland Catchment Management Authority	• Responsible for waterway and catchment management in the Thomson basin

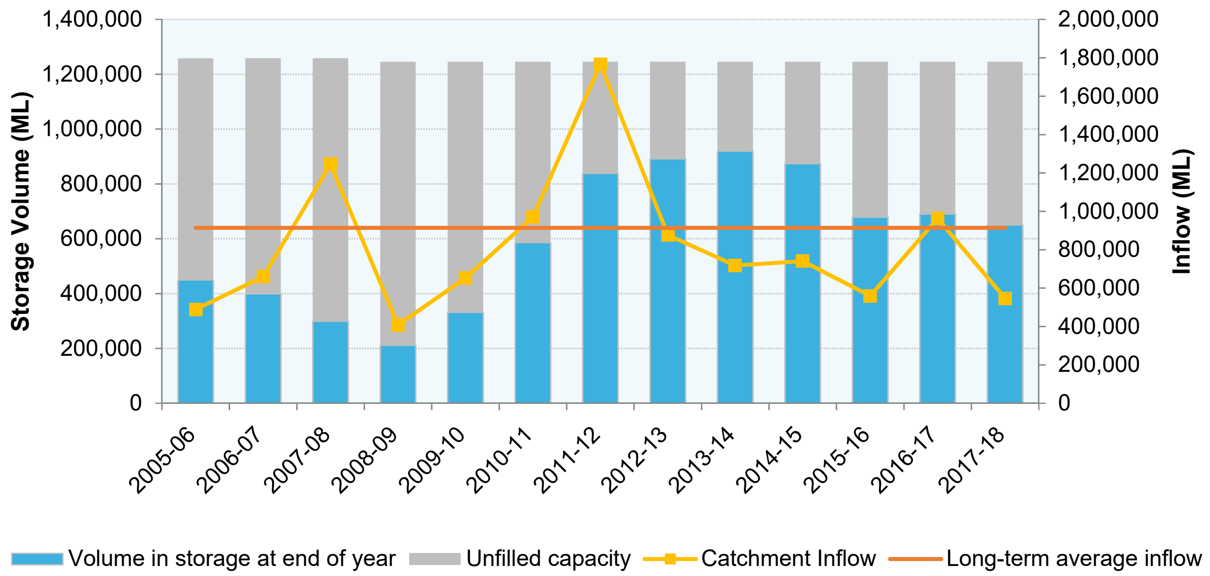
6.13.2 2017–18 Water resource overview

In 2017–18, rainfall throughout the Thomson basin was mostly 60% to 80% of the long-term average. The north-western area — above Licola to the border — received between 80% to 100% of the long-term average.

The long-term average used in the 2017–18 accounts has been revised from previous accounts and is now an average of post-1975 streamflow, as chapter 2.2 explains. Catchment inflows were 60% of the revised long-term average of 914,072 ML: less than the inflows recorded in 2016–17, which were 105% of the revised long-term average.

Storages started the year at 55% of capacity and ended the year slightly lower at 52% of capacity.

Figure 6-24 Storage volumes and catchment inflows in the Thomson basin



In 2017–18, the first seasonal allocation for the Macalister Irrigation District for high-reliability water shares was announced on 7 July 2017 at 45% and increased to 100% by September 2017. A seasonal allocation for low-reliability water shares was announced at 20% on 24 April 2018. This was the final seasonal allocation announced for the year.

Three unregulated streams within the Thomson basin were under restrictions of varying degrees of severity for the whole of 2017–18. Both sections of the Avon River had complete bans on licensed diversions between February and April 2018, with pumping restrictions in place for the rest of the year. Valencia Creek was on a stage 1 roster from July 2017 to September 2017, restrictions from October 2017 to December 2017 and a complete ban from January 2018 to May 2018. It reverted to a stage 1 roster in June 2018.

There were no urban water-use restrictions applied in the Thomson basin in 2017–18, with all towns on permanent water-saving rules throughout the year.

In 2017–18, 377,813 ML of water was diverted for consumptive purposes (town, domestic and stock, irrigation and commercial supply). This was more than the 305,814 ML diverted in the previous year.

Water for the environment

The Gippsland Lakes are important environmental assets partially dependent on water in the Thomson basin. The lakes are listed as internationally significant wetlands under the Ramsar Convention and rely on freshwater inputs from basins including the Thomson basin to function ecologically. Other important environmental assets include:

- the upper Thomson River (a heritage river reach) and its Australian grayling populations
- the Macalister River, supporting seven migratory native fish species, platypus and the water rat.

In 2017–18, water for the environment in the Thomson basin comprised:

- the *Bulk Entitlement (Thomson River – Environment) Order 2005* comprising 3.9% share of inflows (on average 8,000 ML a year) and 10,000 ML of high-reliability entitlement held by the VEWH and water set aside for the environment through the operation of passing flows
- the *Macalister River Environmental Entitlement 2010* comprising 12,461 ML of high-reliability and 6,230 ML of low-reliability entitlements held by the VEWH
- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements held by Southern Rural Water
- water set aside for the environment through the operation of passing flow conditions on licensed diversions
- all other water in the basin not allocated under entitlements: this water also provides social, recreational and cultural benefits.

In 2017–18, a total of 33,956 ML of environmental water was delivered in-stream in the Thomson basin.

6.13.3 Water balance

The total volumes of water available and supplied from water resources in the Thomson basin in 2017–18 are shown in Table 6-76.

Table 6-76 Water balance – Thomson basin

Water account component	Note	2017–18 (ML)	2016–17 (ML)
Major on-stream storage			
Volume in storage at start of year	1	690,671	678,930
Volume in storage at end of year	1	650,555	690,671
Change in storage		**(40,116)**	**11,741**
Inflows			
Catchment inflow	2	546,937	962,204
Rainfall on major storages	1	14,931	22,866
Return flow from irrigation		1,745	2,085
Treated wastewater discharged back to river	3	31	28
Total inflows		**563,644**	**987,182**
Outflows			
Diversions			
Urban diversions		1,490	1,398
Transfers to Yarra River basin for urban use		133,540	86,383
Irrigation district diversions		211,347	185,908
Licensed diversions from regulated streams		26,155	22,040
Licensed diversions from unregulated streams		4,803	4,611
Small catchment dams	4	478	5,475
Total diversions		***377,813***	***305,814***
Losses			
Evaporation losses from major storages	1	18,756	29,822
Evaporation from small catchment dams	4	538	2,398
In-stream infiltration to groundwater, flows to floodplain and evaporation	5	12,761	15,466
Total losses		***32,055***	***47,685***
Water passed at outlet of basin			
River outflows to Latrobe River		164,487	446,042
River outflows to Lake Wellington		29,406	175,900
Total water passed at outlet of basin		***193,893***	***621,942***
Total outflows		**603,760**	**975,441**

Notes to the water balance

1. Storages

Major on-stream storages in the Thomson basin are included in the water balance. A breakdown of the volumes presented are in Table 6-77.

Table 6-77 Storage volumes in the Thomson basin

Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Lake Glenmaggie	177,640	46,215	382	1,183	(2,478)	42,936
Thomson Reservoir (1)	1,068,000	644,456	14,549	17,573	(33,813)	607,619
Total storage volumes 2017–18	**1,245,640**	**690,671**	**14,931**	**18,756**	**(36,291)**	**650,555**
Total storage volumes 2016–17	1,245,640	678,930	22,866	29,822	18,697	690,671

Note

(1) Volumes in store in the Thomson Reservoir do not include 55,100 ML in dead storage.

2. Catchment inflow

Catchment inflow is the balancing item in this water balance. It is the difference between the total outflows, the known inflows and the net change in storage volume.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-78 lists the wastewater treatment plants in the Thomson basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-78 Volume and use of recycled water in the Thomson basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Heyfield	77	77	100%	0	77	0	0	0	0
Maffra	175	175	100%	0	175	0	0	0	0
Rawson	31	0	0%	0	0	0	0	31	0
Sale	974	974	100%	0	974	0	0	0	0
Stratford	169	169	100%	0	169	0	0	0	0
Total 2017–18	**1,426**	**1,395**	**98%**	**0**	**1,395**	**0**	**0**	**31**	**0**
Total 2016–17	1,313	1,285	98%	3	1,281	0	0	28	0

4. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-79 provides information about small catchment dams in the basin.

New hydrological modelling has provided a more-accurate measure of usage and harvested volumes for the 2017–18 reporting period. Therefore, the volumes for small catchment dams in 2016–17 are not directly comparable with the volumes reported for 2017–18. Each year presents the best estimate of the water harvested, used and lost, based on the best information that was available at the time. For more information, see Appendix E and chapter 6.1.2.

Table 6-79 Estimated small catchment dam information for the Thomson basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	5,396	348	486	834
Registered/licensed commercial and irrigation	3,175	130	52	182
Total 2017–18	**8,572**	**478**	**538**	**1,016**
Total 2016–17	8,747	5,475	2,397	7,872

5. In-stream losses

The in-stream loss estimate for the Thomson basin used in the 2017–18 accounts has been revised from previous accounts, as chapter 6.1.2 explains. This has increased the in-stream loss estimate by 7% for 2017–18 (the previous estimate would have resulted in an in-stream loss of 11,886 ML).

6.13.4 Compliance against entitlements

Compliance against water entitlements is reported in these accounts in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Thomson – Key compliance points
✓ **There was a net increase of total entitlement volume of 8,663 ML from the previous year. An increase was made to the volume of high-reliability water shares (5,440 ML) and low-reliability water shares (2,780 ML) during 2017–18. The issue of new water shares was as a result of water recovery generated by efficiency improvements to the Macalister Irrigation District**.
✓ **The total volume diverted (409,546 ML) was within the volume available for the year (467,902 ML).**
✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the Thomson basin provide the basis for how water is shared in the basin. Rights to water in the Thomson basin are outlined in Table 6-80.

Melbourne Water holds a bulk entitlement to divert surface water from the Thomson River. This entitlement is one of four which contribute to the Greater Yarra system – Thomson River Pool which primarily supplies Melbourne and supports regional urban water corporations Barwon Water, Western Water, South Gippsland Water and Westernport Water (Table 6-104 and Table 6-105). Details of the entitlement arrangements are provided in the Yarra basin chapter. Surface water is also diverted by licensed diverters and is harvested in small catchment dams.

The VEWH holds environmental entitlements for the Thomson River and the Macalister River. Water available under these entitlements is used to support streamflows and is not diverted out of waterways in the basin.

Table 6-80 Entitlement volumes in the Thomson basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Thomson Macalister – Southern Rural Water) Conversion Order 2001 (1)	
High-reliability water shares (2)	155,820
Low-reliability water shares (2)	74,605
Bulk Entitlement (Thomson Macalister Towns – Gippsland Water) Conversion Order 2005	2,335
Macalister River Environmental Entitlement 2010 (3)	
Macalister River environmental entitlement – high-reliability	12,461
Macalister River environmental entitlement – low-reliability	6,230
Subtotal: Macalister River Environmental Entitlement 2010	**18,690**
Subtotal: Bulk Entitlement (Thomson Macalister – Southern Rural Water) Conversion Order 2001	**251,450**
Bulk Entitlement (Thomson River – Melbourne Water) Order 2014 (4)	**171,800**
Bulk Entitlement (Thomson River – Environment) Conversion Order 2005 (5)	
Thomson River – high-reliability	10,000
Share of inflows (5)	n/a
Subtotal: Bulk Entitlement (Thomson River – Environment) Conversion Order 2005	**10,000**
Take and use licences – unregulated surface water	**17,237**
Total (30 June 2018)	**450,487**
Total (30 June 2017)	**441,824**

Notes

(1) Under this bulk entitlement, Southern Rural Water operates Lake Glenmaggie and Cowwarr Weir to supply water share holders in the Macalister Irrigation District and diverters on the Thomson and Macalister rivers and Rainbow Creek, and to supply water to Gippsland Water's Thomson Macalister towns bulk entitlement.

(2) The overall volume of high- and low-reliability water shares increased by 5,440 ML and 2,780 ML respectively during 2017–18. This was from issuing customers new water shares for water savings generated by efficiency improvements to the Macalister Irrigation District.

(3) 2017–18 is the first year that the components of this entitlement have been reported in the accounts. This detail has been included to provide more clarity about the entitlement, and it does not represent a change in the entitlement.

(4) This water is used to supply primary entitlement holders — City West Water, South East Water, Yarra Valley Water, Barwon Water, Western Water, South Gippsland Water and Westernport Water — with entitlement to the Greater Yarra system – Thomson River Pool, which sources water from the Yarra River, Thomson River, Tarago River, Silver Creek and Wallaby Creek.

(5) The *Bulk Entitlement (Thomson River – Environment) 2005* previously consisted of a 10,000 ML high-reliability entitlement only. On 1 June 2017, the bulk entitlement was amended to reflect the addition of a new component of the entitlement, consisting of a 3.9% share of inflows into storage, with the actual volume available in any year varying, depending on inflow conditions (8,000 ML a year on average).

Table 6-81 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-81 Available water and take for the Thomson basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Thomson Macalister – Southern Rural Water					
Water shares (1)	-	226,237	0	**226,237**	**187,646**
Thomson Macalister Towns – Gippsland Water	-	2,335	0	**2,335**	**1,490**
Macalister River Environmental Entitlement 2010 (2) (3)	9,950	13,707	0	**23,657**	**15,884**
Operating provisions (4)					**48,111**
Diversion: Thomson Macalister – Southern Rural Water (5)					**253,131**
Thomson River – Melbourne Water (6)	-	171,800	0	**171,800**	**133,540**
Thomson River – Environment (2) (7)	7,438	19,198	0	**26,636**	**18,072**
Take and use licences – unregulated surface water	-	17,237	0	**17,237**	**4,803**
Total 2017–18	**17,388**	**450,514**	**0**	**467,902**	**409,546**
Total 2016–17	3,391	444,056	1	447,448	308,581

Notes

(1) Allocation issued includes 55,495 ML of spill allocation made available to water shares holders in 2017–18. This was available between 2 December and 15 December 2018, following a spill declaration for Lake Glenmaggie.

(2) Water use reported reflects environmental in-stream use. This amount is not reflected in the water balance in Table 6-76 as it does not represent an actual diversion from the waterway. Unused water is available to be carried over under this entitlement (Table 4-4).

(3) The environmental diversion reported here is not included in the total diversion for the Thomson Macalister – Southern Rural Water bulk entitlement as the water was not diverted out of the waterway.

(4) This reflects use of water to manage the system. It includes any loss incurred in supplying the primary entitlements.

(5) The water use reported in this line item represents the net diversion to supply primary entitlements and fulfil other operating requirements under the Thomson Macalister source bulk entitlement (net of return flow from irrigation). It includes in-stream environmental diversions of 15,884.

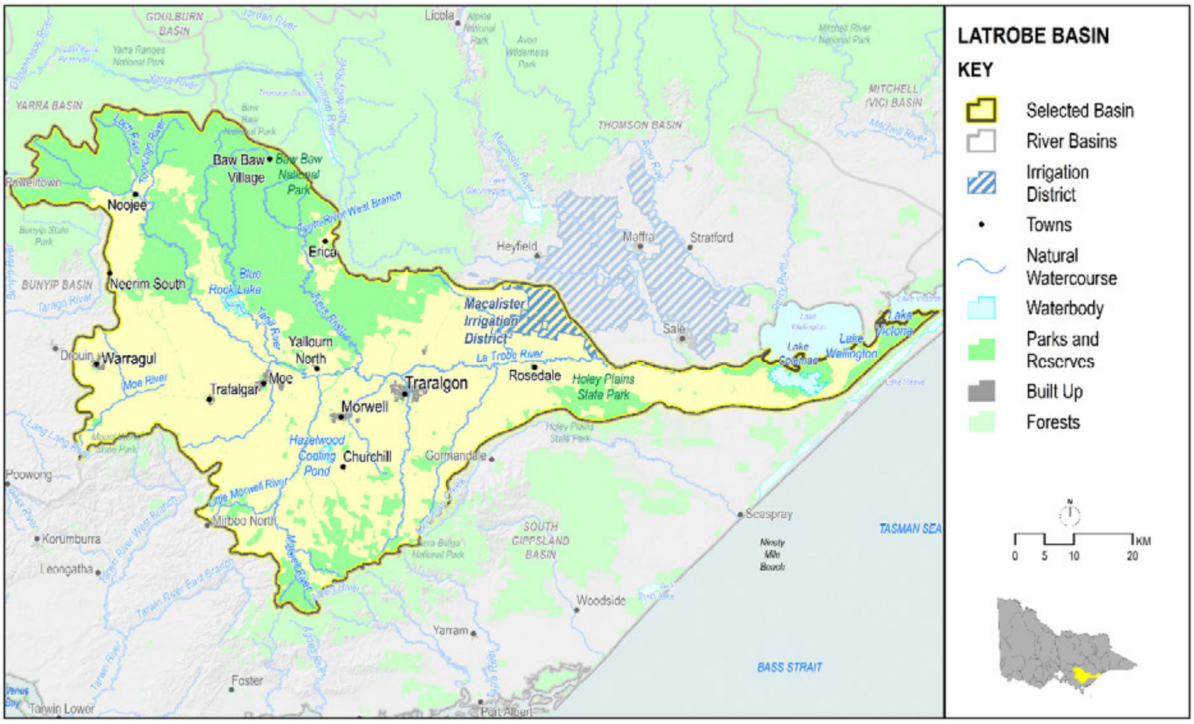
(6) The volume of water taken by Melbourne Water under this bulk entitlement is assessed against a 15-year average annual volume of 171,800 ML. The corresponding average annual volume of diversions over the 15 years to 2017–18 was 104,057 ML. The combined volume of water taken by Melbourne Water from the Thomson basin, Yarra basin and Silver and Wallaby creeks is assessed against a 15-year average annual volume of 555,000 ML. The corresponding average annual volume of diversions over the 15 years to 2017–18 was 386,160 ML.

(7) Allocation and use under the Thomson River – Environment entitlement included 2,500 ML allocated and used under the passing flows component of the entitlement.

6.14 Latrobe basin

The Latrobe basin (Figure 6-25) lies between the Strzelecki Ranges and the Great Dividing Range. The Latrobe River flows east and joins the Thomson River before flowing into the Gippsland Lakes.

Figure 6-25 Map of the Latrobe basin



6.14.1 Management arrangements

Management of water in the Latrobe basin is undertaken by various parties, the responsibilities of which Table 6-82 shows.

Table 6-82 Responsibilities for water resources management in the Latrobe basin

Authority	Management responsibilities
Southern Rural Water	• Manages the Macalister Irrigation District (which is supplied from the Thomson basin) • Manages licensed diversions • Operates part of the Latrobe water supply system including Blue Rock Reservoir and Lake Narracan for supply to Gippsland Water, the VEWH, power stations and licensed diverters
Gippsland Water	• Supplies towns including Moe, Morwell and Traralgon • Provides industrial supply to Hazelwood and Energy Brix power stations and to other major industries • Operates Moondarra Reservoir
West Gippsland Catchment Management Authority	• Responsible for waterway and catchment management in the Latrobe basin

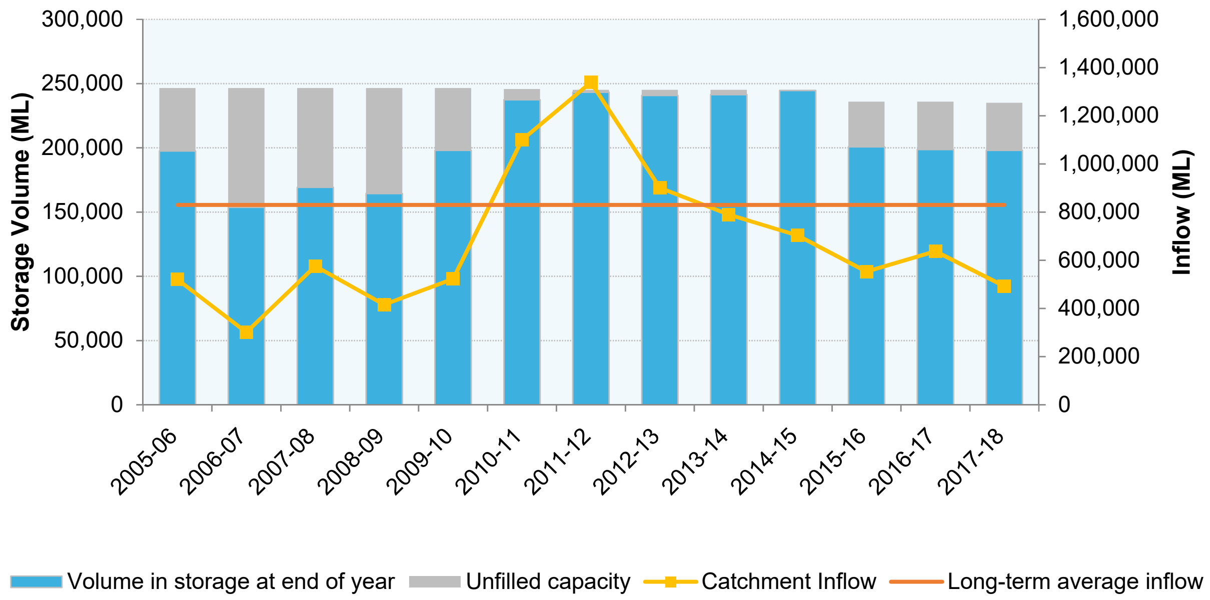
6.14.2 2017–18 Water resource overview

In 2017–18, rainfall throughout the Latrobe basin was mostly 80% to 100% of the long-term average, while the north-eastern portion from Rosedale to the Gippsland Lakes received between 60% to 80% of the long-term average.

The long-term average used in the 2017–18 accounts has been revised from previous accounts and is now an average of post-1975 streamflow, as chapter 2.2 explains. Catchment inflows were 59% of the revised long-term average of 829,757 ML: less than the inflows recorded in 2016–17, which were 77% of the revised long-term average.

The volume of water in major storages remained high throughout the year, with major storages starting and ending the year at 84% of total capacity.

Figure 6-26 Storage volumes and catchment inflows in the Latrobe basin



During the summer of 2018, the Latrobe basin had four unregulated streams on restrictions. A ban was placed on licensed diversions from Middle Creek from February 2018 to May 2018, Traralgon Creek from February 2018 to April 2018, and Ten Mile Creek for the month of March 2018. Morwell River was placed on stage 1 roster during February 2018, which progressed to restrictions for March and April 2018 before reverting to stage 1 in May 2018. All streams were unrestricted in June 2018.

No urban water-use restrictions applied in the Latrobe basin in 2017–18, with all towns on permanent water-saving rules throughout the year.

In 2017–18, 88,090 ML of water was diverted for consumptive purposes (town, domestic and stock, irrigation and commercial supply). This was less than the 143,007 ML diverted in the previous year. Some of the change from the previous year's diversion is related to the reporting of small catchment dam use, which reduced from 22,802 ML last year to only 7,388 ML this year, due to improved hydrological modelling. For more information, see Appendix E.

Water for the environment

The Latrobe River and lower Latrobe wetlands (including Sale Common, Dowd Morass and Heart Morass, which are part of the internationally recognised Gippsland Lakes Ramsar site) depend on water in the Latrobe basin.

The Latrobe River contains some continuous stands of river red gums in the upper reaches. The banks along the lower reaches support stands of swamp scrub, an endangered vegetation group. The Latrobe River contains native estuarine and freshwater fish species including black bream, Australian bass and short- and long-finned eel.

The lower Latrobe wetlands provide habitat for a variety of waterbirds. Mature river red gums also grow adjacent to the wetlands and provide nesting habitat for sea eagles and other birds of prey that hunt in the wetlands.

In 2017–18, water for the environment in the Latrobe basin comprised:

- the *Lower Latrobe Wetlands Environmental Entitlement 2010*, held by the VEWH, which allows water to be diverted to Dowd Morass, Sale Common and Heart Morass when river levels are above heights specified in the environmental entitlement
- the *Blue Rock Environmental Entitlement 2013*, held by the VEWH which in 2017–18 provided a 9.45% share of inflows into Blue Rock Reservoir
- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements held by Southern Rural Water and Gippsland Water
- water set aside for the environment through the operation of passing flow conditions on licensed diversions
- all other water in the basin not allocated for consumptive use: this water also provides social, recreational and cultural benefits.

In 2017–18, a total of 11,224 ML of environmental water was delivered in-stream in the Latrobe basin. Water was also diverted to inundate Sale Common and Dowd Morass, but the volumes delivered to these wetlands are not measured so a volume is not available.

6.14.3 Water balance

The total volumes of water available and supplied from water resources in the Latrobe basin in 2017–18 are shown in Table 6-83.

Table 6-83 Water balance – Latrobe basin

Water account component	Note	2017–18 (ML)	2016–17 (ML)
Major on-stream storage			
Volume in storage at start of year	1	198,676	200,814
Volume in storage at end of year	1	198,075	198,676
Change in storage		**(601)**	**(2,138)**
Inflows			
Catchment inflow	2	492,415	636,929
Rainfall on major storages	1	2,921	9,595
Return flow from power stations and major industry		33,953	40,355
Treated wastewater discharged back to river	3	3,691	3,410
Total inflows		**532,980**	**690,290**
Outflows			
Diversions			
Urban and industrial diversions		103,228	113,713
Licensed diversions from regulated streams		8,490	6,726
Licensed diversions from unregulated streams		6,279	5,766
Small catchment dams	4	7,388	22,802
Total diversions		***125,385***	***149,007***
Losses			
Evaporation losses from major storages	1	4,067	12,407
Evaporation from small catchment dams	4	2,570	5,610
In-stream infiltration to groundwater, flows to floodplain and evaporation	5	n/a	n/a
Total losses		***6,637***	***18,017***
Water passed at outlet of basin			
River outflows to the Gippsland Lakes (excluding Thomson River)		401,559	525,405
Total water passed at outlet of basin		***401,559***	***525,405***
Total outflows		**533,581**	**692,428**

Note
n/a Not applicable.

Notes to the water balance

1. Storages

Major on-stream storages in the Latrobe basin are included in the water balance. A breakdown of the volumes presented are in Table 6-84.

Table 6-84 Storage volumes in the Latrobe basin

Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Blue Rock Lake	198,280	178,139	635	1,257	(9,319)	168,198
Lake Narracan	6,257	1,173	691	0	4,274	6,138
Moondarra Reservoir	30,458	19,364	1,595	2,810	5,590	23,739
Total storage volumes 2017–18	**234,995**	**198,676**	**2,921**	**4,067**	**545**	**198,075**
Total storage volumes 2016–17	235,968	200,814	9,595	12,407	674	198,676

2. Catchment inflow

Catchment inflow is the balancing item in this water balance. It is the difference between the total outflows, the known inflows and the net change in storage volume.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-85 lists the wastewater treatment plants in the Latrobe basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-85 Volume and use of recycled water in the Latrobe basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Mirboo North	109	109	100%	68	40	0	0	0	0
Moe	2,141	0	0%	0	0	0	0	2,141	0
Morwell	586	586	100%	0	0	586	0	0	0
Dutson Downs (regional outfall sewer)	9,038	68	1%	68	0	0	0	0	8,970
Saline wastewater outfall pipeline	8,771	0	0%	0	0	0	0	0	8,771
Warragul	1,550	0	0%	0	0	0	0	1,550	0
Willow Grove	14	14	100%	0	14	0	0	0	0
Total 2017–18	**22,209**	**777**	**3%**	**136**	**54**	**586**	**0**	**3,691**	**17,741**
Total 2016–17	23,488	773	3%	111	46	616	0	3,410	19,305

4. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-86 provides information about small catchment dams in the basin.

New hydrological modelling has provided a more-accurate measure of usage and harvested volumes for the 2017–18 reporting period. Therefore, the volumes for small catchment dams in 2016–17 are not directly comparable with the volumes reported for 2017–18. Each year presents the best estimate of the water harvested, used and lost, based on the best information that was available at the time. For more information, see Appendix E and chapter 6.1.2.

Table 6-86 Estimated small catchment dam information for the Latrobe basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	15,445	3,463	1,797	5,260
Registered/licensed commercial and irrigation	16,064	3,924	773	4,697
Total 2017–18	**31,509**	**7,388**	**2,570**	**9,958**
Total 2016–17	32,286	22,802	5,610	28,412

5. In-stream losses

An assessment of in-stream infiltration to groundwater, flows to floodplain and evaporation is not made in the Latrobe basin as there are no suitable models, and the distribution of streamflow gauges across the basin makes it difficult to estimate in-stream losses (see chapter 6.1.2).

6.14.4 Compliance against entitlements

Compliance against water entitlements is reported in these accounts in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Latrobe – Key compliance points
✓ **There was no net increase to the total entitlement volume from the previous year.**
✓ **The total volume diverted (137,711 ML) was within the volume available for the year (271,227 ML).**
✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the Latrobe basin provide the basis for how water is shared in the basin. Rights to water in the Latrobe basin are outlined in Table 6-87.

The *Lower Latrobe Wetlands Environmental Entitlement 2010* held by the VEWH provides for unregulated flows in the Latrobe River to be diverted to floodplain wetlands. The volume of unregulated flows available for diversion varies, depending on seasonal conditions.

Table 6-87 Entitlement volumes in the Latrobe basin

Water entitlement	Annual entitlement volume (ML)
Blue Rock Environmental Entitlement 2013 (1)	n/a
Bulk Entitlement (Boolarra) Conversion Order 1997	145
Bulk Entitlement (Gippsland Water – Blue Rock) Conversion Order 1997	20,000
Bulk Entitlement (Erica) Conversion Order 1997	340
Bulk Entitlement (Latrobe – Southern Rural) Conversion Order 1996 (2)	13,400
Lower Latrobe Wetlands Environmental Entitlement 2010 (3)	0
Bulk Entitlement (Mirboo North) Conversion Order 1997	270
Bulk Entitlement (Moe – Narracan Creek) Conversion Order 1998	3,884
Bulk Entitlement (Moondarra Reservoir) Conversion Order 1997	62,000
Bulk Entitlement (Noojee) Conversion Order 1997	73
Bulk Entitlement (Thorpdale) Conversion Order 1997 (4)	80
Bulk Entitlement (Latrobe – Loy Yang B) Conversion Order 1996	20,000
Bulk Entitlement (Latrobe – Loy Yang A) Conversion Order 1996	40,000
Bulk Entitlement (Latrobe – Loy Yang 3/4 Bench) Conversion Order 1996	25,000
Bulk Entitlement (Latrobe – Yallourn) Conversion Order 1996	36,500
Bulk Entitlement (Latrobe Reserve) Order 2013 (5)	n/a
Take and use licences – unregulated surface water	18,891
Total (30 June 2018)	**240,583**
Total (30 June 2017)	**240,597**

Notes

(1) The *Blue Rock Environmental Entitlement 2013* consists of a 9.45% share of inflows into storage, with the actual volume available in any year varying depending on inflow conditions.
(2) This entitlement supplies water for take and use licences on the Tanjil River and the lower Latrobe River: 11,215 ML of entitlement was issued for take and use licences for the 2017–18 year.
(3) Use of this entitlement depends on suitable river heights, as specified in the entitlement.
(4) Thorpdale is no longer supplied from the Easterbrook Creek under the Thorpdale Bulk Entitlement. Since September 2015, Thorpdale has been supplied by water-carting from the Moe treated water system. This is now the normal supply mode for Thorpdale.
(5) The Latrobe Reserve consists of a 18.87% share of inflows into Blue Rock Reservoir after passing flow requirements have been met. This bulk entitlement is held by Southern Rural Water and managed in line with very specific rules to provide a reserve of water for the bulk/environmental entitlement holders and section 51 licence holders in the Latrobe regulated system.
n/a Not applicable.

Table 6-88 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-88 Available water and take for the Latrobe basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Blue Rock environmental entitlement (1)	15,622	7,271	0	**22,894**	**11,224**
Boolarra	-	145	0	**145**	**0**
Gippsland Water – Blue Rock	-	15,150	0	**15,150**	**3,756**
Erica	-	340	0	**340**	**59**
Latrobe – Southern Rural Water (2)	-	13,084	(2)	**13,082**	**8,490**
Lower Latrobe wetlands environmental entitlement (3)	-	-	-	**-**	**-**
Mirboo North	-	270	0	**270**	**181**
Moe – Narracan Creek	-	3,884	0	**3,884**	**1,718**
Moondarra Reservoir	-	62,000	0	**62,000**	**34,578**
Noojee (4)	-	73	0	**73**	**0**
Thorpdale	-	80	0	**80**	**0**
Latrobe – Loy Yang B	-	20,000	0	**20,000**	**12,637**
Latrobe – Loy Yang A	-	40,000	0	**40,000**	**23,885**
Latrobe – Loy Lang 3/4 Bench	-	25,000	0	**25,000**	**0**
Latrobe – Yallourn	-	36,500	0	**36,500**	**26,414**
Latrobe Reserve	-	-	-	**-**	**-**
Take and use licences – unregulated surface water	-	18,735	(8)	**18,727**	**6,279**
Total 2017–18	**15,622**	**255,617**	**(12)**	**271,227**	**137,711**
Total 2016–17	0	258,509	744	259,253	129,918

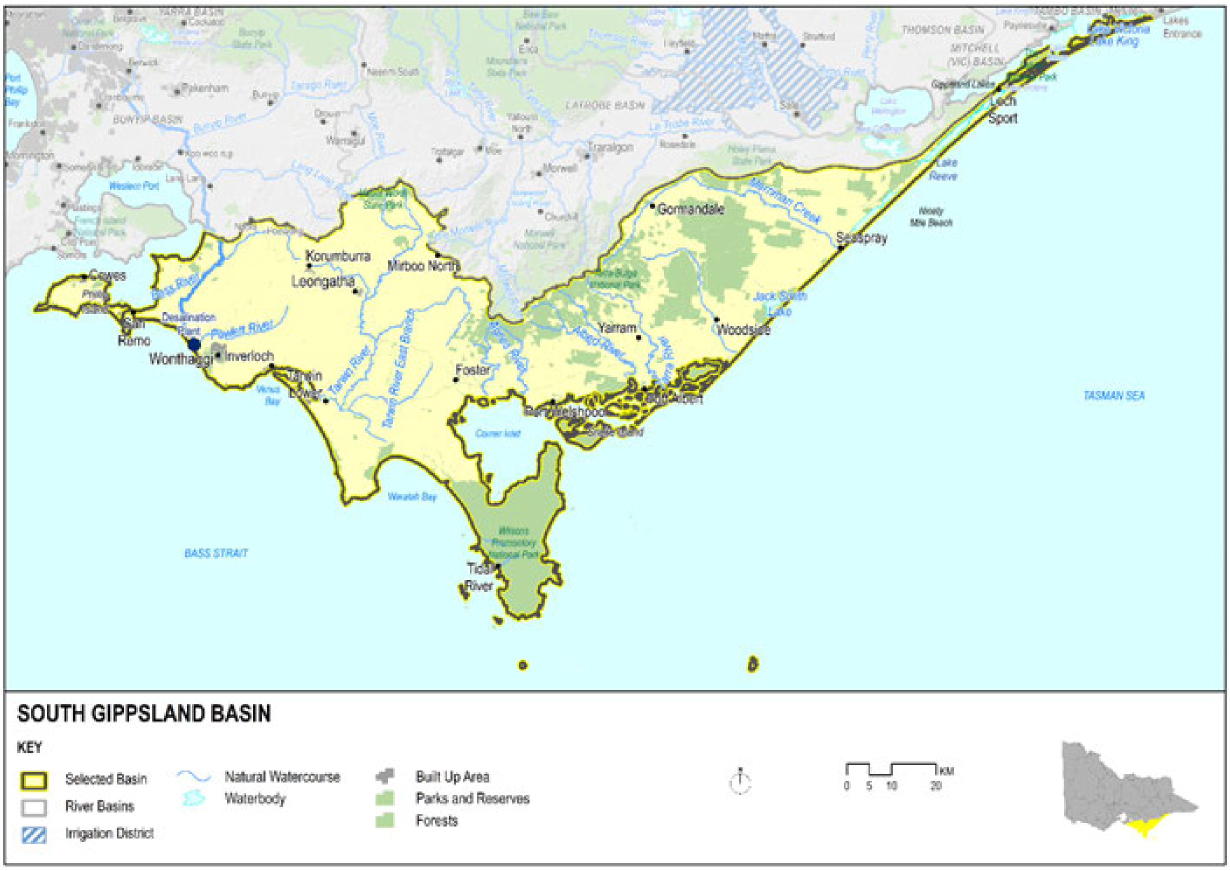
Notes

(1) Water use reported reflects environmental in-stream use. This amount is not reflected in the water balance in Table 6-83, as it is not an actual diversion from the waterway. Unused water is available to carry over in this system. For details refer to Table 4-4.
(2) This represents the water allocated and used by take and use licence holders. Allocation issued includes 1,699 ML of water allocated to take and use licences under spill rules.
(3) Use of this entitlement depends on suitable river heights, as specified in the entitlement. In 2017–18, water under this entitlement was used to inundate Sale Common and Dowd Morass. Volumes delivered in the wetlands are not measured.
(4) Gippsland Water is not taking water from the Loch River under its Noojee bulk entitlement and instead supplies Noojee from Tarago Reservoir in the Bunyip basin.

6.15 South Gippsland basin

The South Gippsland basin (Figure 6-27) is located in south-east Victoria. The basin includes the Bass River, which flows into Western Port and smaller rivers that flow directly into Bass Strait.

Figure 6-27 Map of the South Gippsland basin



6.15.1 Management arrangements

Management of water in the South Gippsland basin is undertaken by various parties, the responsibilities of which Table 6-89 shows.

Table 6-89 Responsibilities for water resources management in the South Gippsland basin

Authority	Management responsibilities
Southern Rural Water	• Manages surface water licensed diversions
South Gippsland Water	• Supplies towns including Leongatha, Inverloch, Wonthaggi, Korumburra and Foster
Westernport Water	• Supplies towns including San Remo and Phillip Island
Gippsland Water	• Supplies towns in the far east of the basin including Seaspray
West Gippsland Catchment Management Authority	• Manages most waterways and catchment in the South Gippsland basin •
Melbourne Water	• Manages waterways in the far west of the South Gippsland basin
AquaSure (Consortium of Thiess and Suez)	• Operate the Victorian Desalination Project, located near Wonthaggi

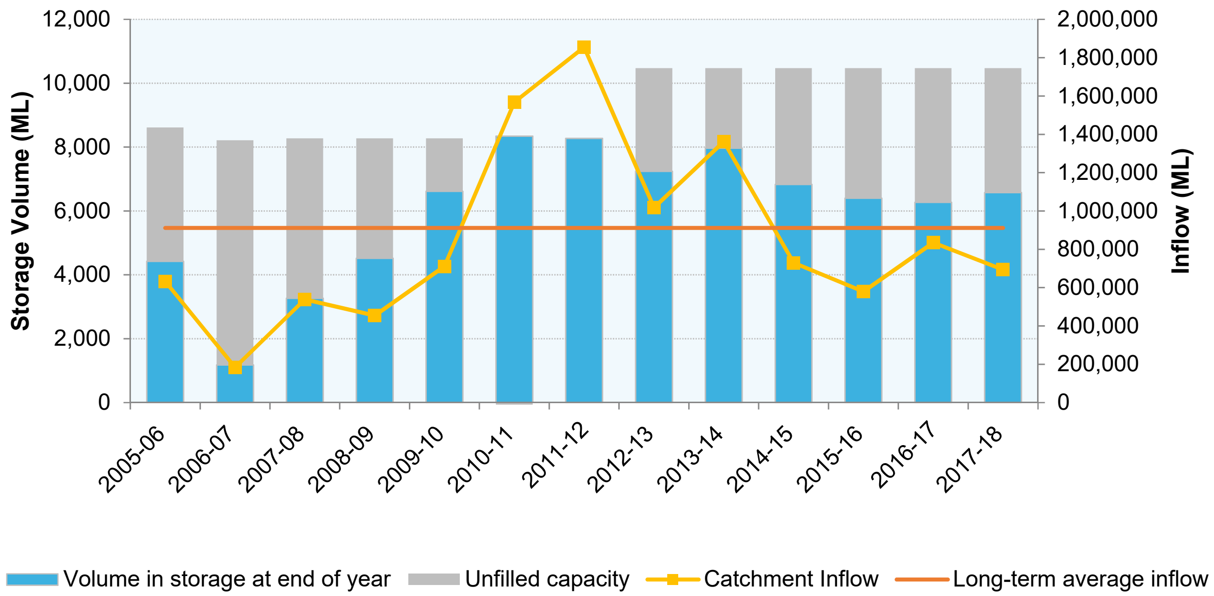
6.15.2 2017–18 Water resource overview

In 2017–18, most of the South Gippsland basin had rainfall between 80% and 100% of the long-term average, with the north-east corner receiving between 60% and 80%.

Catchment inflows were 76% of the long-term average of 911,500 ML: less than the inflows recorded in 2016–17, which were 92% of the long-term average. Unlike in most basins, the long-term average has not been revised for the South Gippsland basin in 2017–18. The average will be reviewed in the 2018–19 accounts, as chapter 2.2 explains. The amount of water flowing from the South Gippsland basin into Bass Strait and Western Port represented 96% of the total inflows to the basin in 2017–18.

Storage levels in the South Gippsland basin started 2017–18 at 62% of total capacity and ended at 63%.

Figure 6-28 Storage volumes and catchment inflows in the South Gippsland basin



Streams remained unrestricted in the South Gippsland basin from July to September 2017. Bans were then placed on Bruthen and Merrimans creeks in October and Greigs Creek in November, and they remained in place until 30 June 2018. The Tarra River was initially placed on a stage 1 roster in November, which was then increased to a total ban from December 2017 to the end of June 2018. The Albert and Jack rivers also had bans on licensed diversions in place from late January until 18 June 2018.

For urban customers, South Gippsland Water applied stage 1 water restrictions to Korumburra in July 2017, which were lifted in August 2017. South Gippsland Water applied stage 2 restrictions to Korumburra again in April 2018, which were later increased to stage 3 in May 2018. These restrictions remained in place in Korumburra until 30 June 2018. All other towns in the South Gippsland basin in 2017–18 were on permanent water-saving rules throughout the year.

In 2017–18, 25,598 ML of water was diverted for consumptive purposes (town, domestic and stock, irrigation and commercial supply). This was less than the 38,735 ML diverted in the previous year. A large portion (28,387 ML) of last years' diversion was the reporting of small catchment dam use, which has reduced this year to 14,419 ML, due to improved hydrological modelling. For more information, see Appendix E.

Water for the environment

Important environmental assets in the South Gippsland basin depend on water. These include:

- the Bald Hills Wetland, which is a rehabilitated wetland complex that supports rare and intact vegetation communities in a largely agricultural environment
- the Bunurong Coast wetlands, which provide habitat connectivity with the marine and estuarine systems
- Corner Inlet and Western Port, which are listed as internationally significant wetlands under the Ramsar Convention and rely on freshwater inputs from the South Gippsland basin to function ecologically
- the Australian grayling population, listed in the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* and the Victorian *Flora and Fauna Guarantee Act 1988*, which also relies on water for the environment.

In 2017–18, water for the environment in the South Gippsland basin comprised:

- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements held by Gippsland Water and South Gippsland Water
- water set aside for the environment through the operation of passing flow conditions on licensed diversions
- all other water in the basin not allocated for consumptive use: this water also provides social, recreational and cultural benefits.

6.15.3 Water balance

The total volumes of water available and supplied from water resources in the South Gippsland basin in 2017–18 are shown in Table 6-90.

Table 6-90 Water balance – South Gippsland basin

Water account component	Note	2017–18 (ML)	2016–17 (ML)
Major on-stream storage			
Volume in storage at start of year	1	6,270	6,398
Volume in storage at end of year	1	6,576	6,270
Change in storage		**306**	**(128)**
Inflows			
Catchment inflow	2	694,156	835,065
Rainfall on major storages	1	1,602	1,654
Treated wastewater discharged back to river	3	1,199	1,229
Total inflows		**696,958**	**837,949**
Outflows			
Diversions			
Urban diversions		7,871	7,906
Licensed diversions from unregulated streams		3,308	2,443
Small catchment dams	4	14,419	28,387
Total diversions		***25,598***	***38,735***
Losses			
Evaporation losses from major storages	1	1,760	999
Evaporation from small catchment dams	4	6,344	7,747
In-stream infiltration to groundwater, flows to floodplain and evaporation	5	n/a	n/a
Total losses		***8,104***	***8,746***
Water passed at outlet of basin			
River outflows to Bass Strait and Westernport		662,949	790,595
Total water passed at outlet of basin		***662,949***	***790,595***
Total outflows		**696,652**	**838,077**

Note
n/a Not applicable.

Notes to the water balance

1. Storages

Major on-stream storages in the South Gippsland basin are included in the water balance. A breakdown of the volumes presented are in Table 6-91.

Table 6-91 Storage volumes in the South Gippsland basin

Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Candowie Reservoir	4,463	2,416	428	585	259	2,518
Hyland Reservoir	671	328	90	91	(134)	193
Lance Creek Reservoir	4,200	3,089	945	945	(8)	3,081
Western Reservoir	1,137	437	139	139	347	784
Total storage volumes 2017–18	**10,471**	**6,270**	**1,602**	**1,760**	**464**	**6,576**
Total storage volumes 2016–17	10,471	6,398	1,654	999	(783)	6,270

2. Catchment inflow

Catchment inflow is the balancing item in this water balance. It is the difference between the total outflows, the known inflows and the net change in storage volume.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-92 lists the wastewater treatment plants in the South Gippsland basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Recycling opportunities within the basin are limited, due to a small industrial base and crop types that are not suited to recycled water. Westernport Water reuses water from its treatment plants at Coronet Bay and Cowes for sporting fields and significant gardens. Gippsland Water operates the Seaspray treatment plant and reuses all the recycled water to irrigate pasture.

Table 6-92 Volume and use of recycled water in the South Gippsland basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Coronet Bay	211	189	89%	0	189	0	0	0	23
Cowes	1,326	140	10%	69	61	0	11	0	1,186
Foster	147	0	0%	0	0	0	0	0	147
Korumburra	631	0	0%	0	0	0	0	631	0
Leongatha Domestic	546	0	0%	0	0	0	0	546	0
Leongatha Trade Waste	773	0	0%	0	0	0	0	0	773
Meeniyan	32	9	28%	8	1	0	0	23	0
Seaspray	12	12	100%	0	12	0	0	0	0
Toora	31	4	13%	4	0	0	0	0	27
Waratah Bay	14	14	100%	0	14	0	0	0	0
Welshpool	48	0	0%	0	0	0	0	0	48
Wonthaggi / Cape Paterson / Inverloch	1,355	0	0%	0	0	0	0	0	1,355
Yarram / Tarraville	96	96	100%	0	96	0	0	0	0
Total 2017–18	**5,222**	**464**	**9%**	**81**	**373**	**0**	**11**	**1,200**	**3,559**
Total 2016–17	5,351	443	8%	71	360	0	12	1,229	3,680

4. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-93 provides information about small catchment dams in the basin.

New hydrological modelling has provided a more-accurate measure of usage and harvested volumes for the 2017–18 reporting period. Therefore, the volumes for small catchment dams in 2016–17 are not directly comparable with the volumes reported for 2017–18. Each year presents the best estimate of the water harvested, used and lost, based on the best information that was available at the time. For more information, see Appendix E and chapter 6.1.2.

Table 6-93 Estimated small catchment dam information for the South Gippsland basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	31,808	9,763	5,346	15,108
Registered/licensed commercial and irrigation	13,990	4,657	999	5,655
Total 2017–18	**45,798**	**14,419**	**6,344**	**20,764**
Total 2016–17	46,927	28,387	7,747	36,134

5. In-stream losses

An assessment of in-stream infiltration to groundwater, flows to floodplain and evaporation was not made in the South Gippsland basin as there are no suitable models, and the distribution of streamflow gauges across the basin makes it difficult to estimate in-stream losses (as chapter 6.1.2 explains).

6.15.4 Compliance against entitlements

Compliance against water entitlements is reported in these accounts in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

South Gippsland – Key compliance points	
✓	**There was no net increase to the total entitlement volume from the previous year.**
✓	**The total volume diverted (11,179 ML) was within the volume available for the year (31,856 ML).**
✓	**No individual bulk entitlement holder took more than the annual volume made available to them.**
✓	**Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the South Gippsland basin provide the basis for how water is shared in the basin. Rights to water in the South Gippsland basin are outlined in Table 6-94.

Table 6-94 Entitlement volumes in the South Gippsland basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Devon North Alberton-Yarram and Port Albert) Conversion Order 1997	853
Bulk Entitlement (Dumbalk) Conversion Order 1997	100
Bulk Entitlement (Fish Creek) Conversion Order 1997	251
Bulk Entitlement (Foster) Conversion Order 1997	326
Bulk Entitlement (Korumburra) Conversion Order 1997	1,000
Bulk Entitlement (Leongatha) Conversion Order 1997	2,476
Bulk Entitlement (Loch, Poowong and Nyora) Conversion Order 1997	420
Bulk Entitlement (Meeniyan) Conversion Order 1997	200
Bulk Entitlement (Seaspray) Conversion Order 1997	133
Bulk Entitlement (Toora Port Franklin-Welshpool and Port Welshpool) Conversion Order 1997	1,617
Bulk Entitlement (Westernport) Conversion Order 1997	2,911
Bulk Entitlement (Westernport-Bass River) Order 2009	3,000
Bulk Entitlement (Wonthaggi-Inverloch) Conversion Order 1997	5,600
Take and use licences – unregulated surface water	12,743
Total (30 June 2018)	**31,630**
Total (30 June 2017)	**31,700**

Table 6-95 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

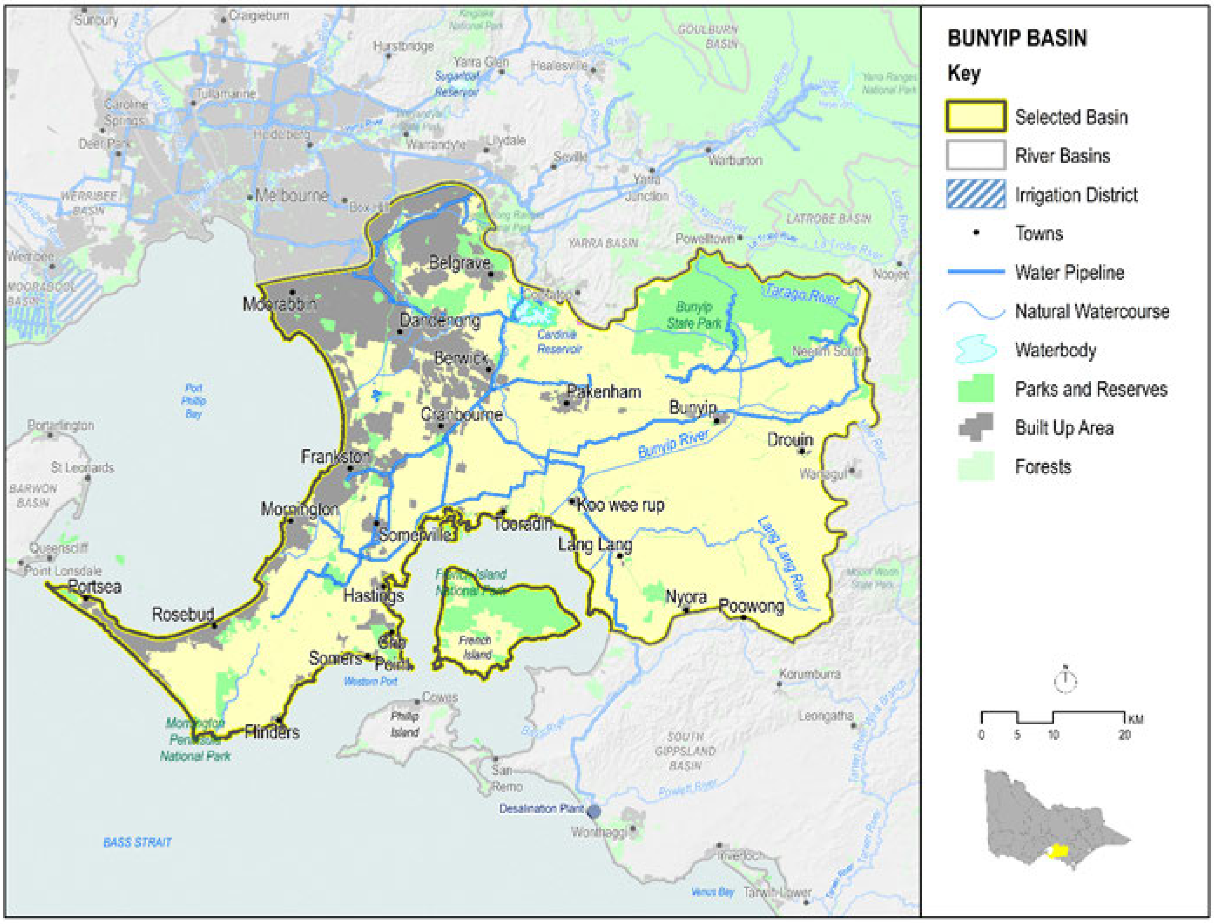
Table 6-95 Available water and take for the South Gippsland basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Devon North Alberton-Yarram and Port Albert	-	853	0	853	453
Dumbalk	-	100	0	100	19
Fish Creek	-	251	0	251	117
Foster	-	326	0	326	170
Korumburra	-	1,000	0	1,000	697
Leongatha	-	2,476	0	2,476	1,542
Loch, Poowong and Nyora	-	420	0	420	266
Meeniyan	-	200	0	200	69
Seaspray	-	133	0	133	35
Toora Port Franklin-Welshpool and Port Welshpool	-	1,617	0	1,617	551
Westernport	-	2,911	0	2,911	2,059
Westernport-Bass River	-	3,000	0	3,000	272
Wonthaggi-Inverloch	-	5,600	0	5,600	1,621
Take and use licences – unregulated surface water	-	12,971	(2)	12,969	3,308
Total 2017–18	**-**	**31,858**	**(2)**	31,856	11,179
Total 2016–17	-	31,711	(3)	31,708	10,349

6.16 Bunyip basin

The Bunyip basin (Figure 6-29) is located in south-east Victoria. The basin includes the Lang Lang and Bunyip rivers which flow into Western Port and the Patterson River which flows into Port Phillip Bay. The south-eastern suburbs of Melbourne are located within the Bunyip basin.

Figure 6-29 Map of the Bunyip basin



6.16.1 Management arrangements

Management of water in the Bunyip basin is undertaken by various parties, the responsibilities of which Table 6-96 shows.

Table 6-96 Responsibilities for water resources management in the Bunyip basin

Authority	Management responsibilities
Southern Rural Water	• Manages surface water and private diversions
Melbourne Water	• Operates Eastern Treatment Plant • Provides bulk water supply to South East Water • Operates Tarago Reservoir • Responsible for waterway management in the Bunyip basin
South East Water	• Supplies part of the metropolitan Melbourne area including Dandenong, Frankston, Pakenham and the Mornington Peninsula [(1)]
Gippsland Water	• Supplies towns in the east of the basin including Drouin and Neerim South
Port Phillip and Westernport Catchment Management Authority	• Responsible for catchment management in the Bunyip basin

Note

(1) Metropolitan Melbourne is mostly supplied from the Yarra and Thomson basins.

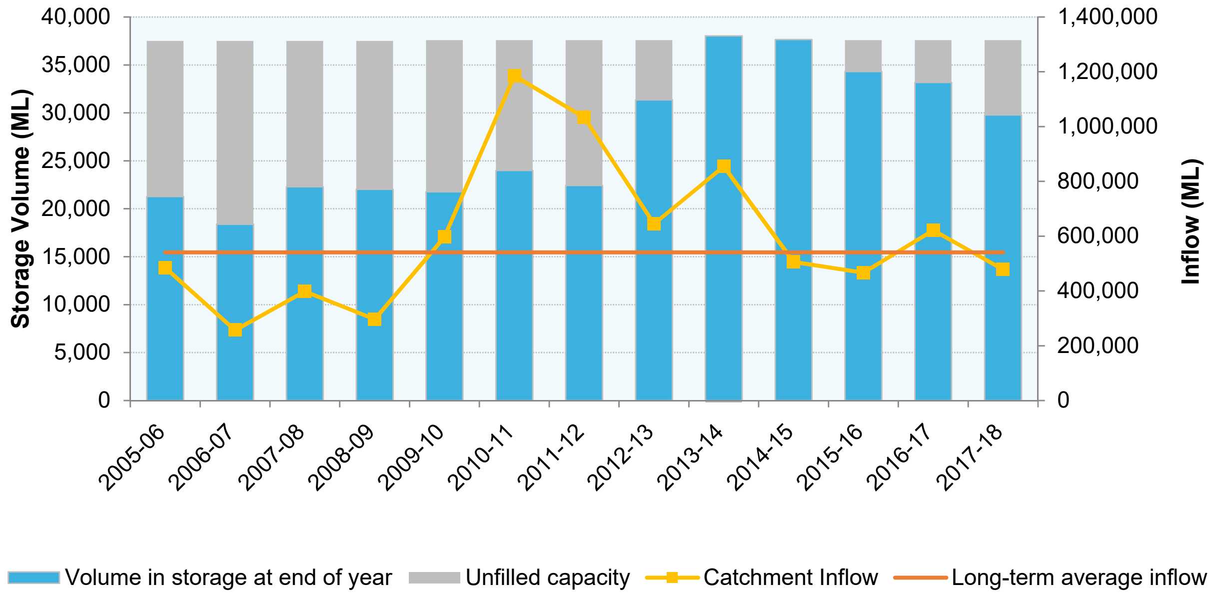
6.16.2 2017–18 Water resource overview

In 2017–18, rainfall in the Bunyip basin was between 80% and 100% of the long-term average.

Catchment inflows to the Bunyip basin in 2017–18 were 88% of the long-term average (541,000 ML): less than the inflows recorded in 2016–17, which were 115% of the long-term average. Unlike most basins, the long-term average has not been revised for the Bunyip basin in 2017–18. The average will be reviewed in the 2018–19 accounts, as chapter 2.2 explains.

Storage levels in the Bunyip basin started 2017–18 at 88% of total capacity and ended at 79%.

Figure 6-30 Storage volumes and catchment inflows in the Bunyip basin



All unregulated streams remained unrestricted throughout 2017–18 except for the Lang Lang River, which maintained relatively steady flows through until February 2018. However, restrictions on diversions were implemented in April 2018.

There were no urban water-use restrictions applied in the Bunyip basin in 2017–18, with all towns on permanent water-saving rules throughout the year.

In 2017–18, 42,310 ML of water was diverted for consumptive purposes (town, domestic and stock, irrigation and commercial supply). This was less than the 57,842 ML diverted in the previous year. A large portion (32,837 ML) of last year's diversion was reporting of small catchment dam use, which has reduced this year to 12,590 ML, due to improved hydrological modelling. For more information, see Appendix E.

Water for the environment

Western Port is an important environmental asset dependent on water in the Bunyip basin. The bay is listed as an internationally significant wetland under the Ramsar Convention and relies on the freshwater inputs from the Bunyip basin to maintain healthy ecological functions. There are also populations of threatened dwarf galaxias and Australian grayling in the Tarago and Bunyip systems.

In 2017–18, water for the environment in the Bunyip basin comprised:

- the *Tarago and Bunyip Rivers Environmental Entitlement 2009*, comprising 10.3% of inflows (on average 3,000 ML a year) held by the VEWH
- water set aside for the environment through the operation of passing flows released as a condition of the consumptive bulk entitlements held by Gippsland Water and Melbourne Water
- water set aside for the environment through the operation of passing flow conditions on licensed diversions
- all other water in the basin not allocated for consumptive use: this water also provides social, recreational and cultural benefits.

In 2017–18, 1,764 ML of environmental water was delivered in-stream in the Bunyip basin.

6.16.3 Water balance

The total volumes of water available and supplied from water resources in the Bunyip basin in 2017–18 are shown in Table 6-97.

Table 6-97 Water balance – Bunyip basin

Water account component	Note	2017–18 (ML)	2016–17 (ML)
Major on-stream storage			
Volume in storage at start of year	1	33,181	34,303
Volume in storage at end of year	1	29,783	33,181
Change in storage		**(3,398)**	**(1,122)**
Inflows			
Catchment inflow	2	478,488	621,609
Rainfall on major storages	1	3,140	3,200
Treated wastewater discharged back to river	3	2,252	769
Total inflows		**483,880**	**625,578**
Outflows			
Diversions			
Urban diversions		22,797	19,374
Licensed diversions from regulated streams		1,507	756
Licensed diversions from unregulated streams		5,416	4,875
Small catchment dams	4	12,590	32,837
Total diversions		***42,310***	***57,842***
Losses			
Evaporation losses from major storages	1	2,383	2,468
Evaporation from small catchment dams	4	5,993	3,240
In-stream infiltration to groundwater, flows to floodplain and evaporation		866	847
Total losses		***9,241***	***6,555***
Water passed at outlet of basin			
River outflows to Port Phillip Bay and Westernport Bay		435,726	562,303
Total water passed at outlet of basin		***435,726***	***562,303***
Total outflows		**487,278**	**626,700**

Notes to the water balance

1. Storages

Major on-stream storages in the Bunyip basin are included in the water balance. A breakdown of the volumes presented are in Table 6-98.

Table 6-98 Storage volumes in the Bunyip basin

Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Tarago Reservoir	37,580	33,181	3,140	2,383	(4,155)	29,783
Total storage volumes 2017–18	**37,580**	**33,181**	**3,140**	**2,383**	**(4,155)**	**29,783**
Total storage volumes 2016–17	37,580	34,303	3,200	2,468	(1,854)	33,181

2. Catchment inflow

Catchment inflow is the balancing item in this water balance. It is the difference between the total outflows, the known inflows and the net change in storage volume.

The 2016–17 catchment inflow volume has been corrected from the previous accounts. An error was made with the treated wastewater discharged to environment volume, which in turn caused an error in the catchment inflow amount.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-99 lists the wastewater treatment plants in the Bunyip basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

The 2016–17 treated wastewater discharged back to river and catchment inflow figure have been corrected from the 2016–17 published accounts.

Table 6-99 Volume and use of recycled water in the Bunyip basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Blind Bight	190	190	90%	171	0	0	19	0	0
Boneo [(1)]	4,258	1,664	32%	1,342	0	0	321	0	2,594
Drouin	809	107	13%	16	90	0	0	586	116
Eastern Treatment Plant [(2)]	139,211	17,274	5%	7,015	0	0	10,259	0	121,937
Kooweerup	246	222	26%	64	0	0	158	0	24
Lang Lang [(3)]	64	27	22%		14	0	13	80	(43)
Longwarry [(4)]	223	191	86%	0	191	0	0	131	(100)
Mt Martha	5,664	973	1%	76	0	0	897	0	4,691
Neerim South	48	0	0%	0	0	0	0	48	0
Pakenham	1,148	943	75%	498	364	0	81	0	205
Somers [(4)]	1,754	354	15%	252	7	0	95	1,406	(6)
Total 2017–18	**153,613**	**21,945**	**7%**	**9,434**	**666**	**0**	**11,843**	**2,252**	**129,418**
Total 2016–17 [(5)]	159,110	18,174	4%	6,419	519	0	11,235	769	140,167

Notes

(1) The 2,594 ML Volume of other discharges figure is made up of 3,240 ML outflow to Bass Strait and a -646 ML other amount. The other amount is negative due to the inclusion of a potable top-up within the effluent re-use volume and to the change in volume in storage lagoons between the start and end of the year.

(2) In 2017–18, 7,015 ML was diverted to retailers. This was previously reported as a separate type of end use and has been incorporated into the total urban and industrial use. In 2016–17, 5,282 ML was diverted to the retailers.

(3) The volume of other discharges is negative due to the change in the volume in storage lagoons between the start and end of the year.

(4) The volume of other discharges is negative due to the inclusion of a potable top-up within the effluent re-use volume and to the change in the volume in storage lagoons between the start and end of the year.

(5) Volumes for 2016–17 have been corrected from the 2016–17 accounts.

4. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-100 provides information about small catchment dams in the basin.

New hydrological modelling has provided a more-accurate measure of usage and harvested volumes for the 2017–18 reporting period. Therefore, the volumes for small catchment dams in 2016–17 are not directly comparable with the volumes reported for 2017–18. Each year presents the best estimate of the water harvested, used and lost, based on the best information that was available at the time. For more information, see Appendix E and chapter 6.1.2.

Table 6-100 Estimated small catchment dam information for the Bunyip basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	23,338	6,036	4,010	10,046
Registered/licensed commercial and irrigation	23,913	6,554	1,983	8,537
Total 2017–18	**47,251**	**12,590**	**5,993**	**18,583**
Total 2016–17	48,752	32,837	3,239	36,076

5. In-stream losses

The method used to estimate in-stream loss in the Bunyip basin used in the 2017–18 accounts has been revised from previous accounts, as chapter 6.1.2 explains. This has increased the in-stream loss estimate by 22% for 2017–18: the previous method would have estimated the in-stream loss to be 710 ML rather than 866 ML.

6.16.4 Compliance against entitlements

Compliance against water entitlements is reported in these accounts in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Bunyip – Key compliance points

- ✓ **There was no net increase to total entitlement volume from the previous year.**
- ✓ **The total volume diverted (31,484 ML) was within the volume available for the year (58,733 ML).**
- ✓ **No individual bulk entitlement holder took more than the annual volume made available to them. Southern Rural Water took more than their yearly limit under the Tarago River – Southern Rural Water bulk entitlement. This is allowed under the provisions of the entitlement, as there is a maximum take of 6,300 ML over any five-year period. Overuse in any one year is within obligations, as long as the five-year rolling volume of take does not exceed 6,300 ML.**
- ✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the Bunyip basin provide the basis for how water is shared in the basin. Rights to water in the Bunyip basin are outlined in Table 6-101.

Melbourne Water holds a bulk entitlement to divert surface water in the Bunyip basin. This entitlement is one of four that contribute to the Greater Yarra system – Thomson River Pool which primarily supplies Melbourne and supports regional urban water corporations Barwon Water, Western Water, South Gippsland Water and Westernport Water (Table 6-104 and Table 6-105).

The *Tarago and Bunyip Rivers Environmental Entitlement 2009* provides the VEWH with a 10.3% share of inflows to Tarago Reservoir. The water available under the entitlement is used to support streamflows and is not diverted out of the waterway.

Table 6-101 Entitlement volumes in the Bunyip basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Tarago River – Gippsland Water) Conversion Order 2009 (1)	4,825
Bulk Entitlement (Tarago River – Southern Rural Water) Conversion Order 2009 (2)	1,260
Bulk Entitlement (Tarago and Bunyip Rivers – Melbourne Water) Order 2014 (3)	30,510
Tarago and Bunyip Rivers Environmental Entitlement 2009 (4)	n/a
Take and use licences – unregulated surface water	18,862
Total (30 June 2018)	**55,457**
Total (30 June 2017)	**55,491**

Notes

(1) The maximum volume that can be taken each year is 275 ML plus 22,750 ML over any five-year period (4,550 ML annual average).
(2) The maximum volume that can be taken over any five-year period is 6,300 ML (1,260 ML annual average).
(3) Melbourne Water holds the source bulk entitlement on the Tarago and Bunyip rivers and can take an average annual amount of up to 30,510 ML over any consecutive five-year period. This water is used to supply primary entitlement holders (City West Water, South East Water, Yarra Valley water, Barwon Water, Western Water, South Gippsland Water and Westernport Water) with entitlement to the Greater Yarra system – Thomson River Pool which sources water from the Yarra River, Thomson River, Tarago River, Silver Creek and Wallaby Creek.
(4) The *Tarago and Bunyip Rivers Environmental Entitlement 2009* consists of a 10.3% share of inflows into storage, with the actual volume available in any year varying, depending on inflow conditions.
n/a Not applicable.

Table 6-102 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-102 Available water and take for the Bunyip basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Tarago River – Gippsland Water	-	4,825	0	**4,825**	**3,756**
Tarago River – Southern Rural Water (1)	-	1,260	0	**1,260**	**1,507**
Tarago and Bunyip rivers – Melbourne Water	-	30,510	0	**30,510**	**19,041**
Tarago and Bunyip rivers environmental entitlement (2)	1,658	1,559	0	**3,217**	**1,764**
Take and use licences – unregulated surface water	-	18,922	(1)	**18,921**	**5,416**
Total 2017–18	**1,658**	**57,076**	**(1)**	**58,733**	**31,484**
Total 2016–17	1,648	57,459	0	59,107	26,957

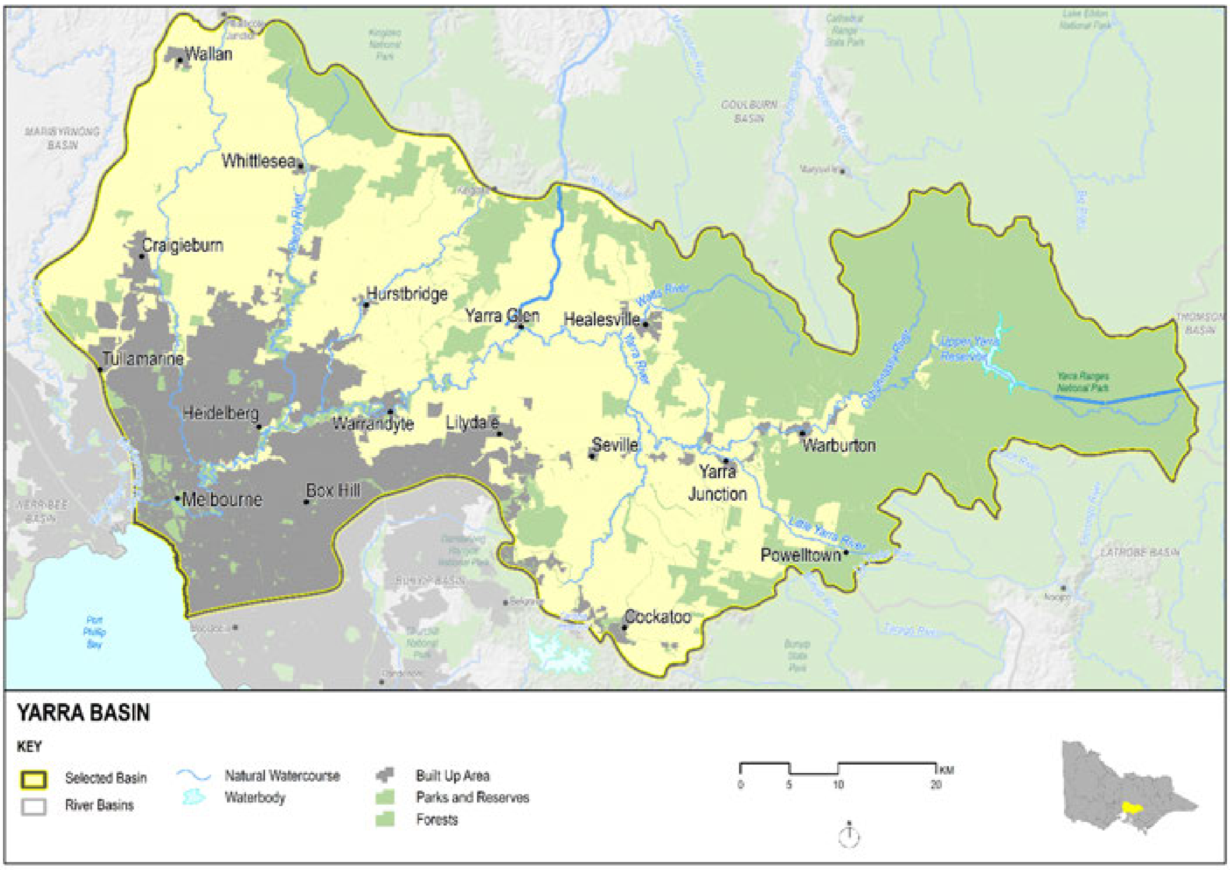
Notes

(1) Water use represents the volume of water ordered via regulated release from Tarago Reservoir to supply licensed diverters downstream of Tarago Reservoir. Water released from Tarago Reservoir to supply Southern Rural Water section 51 licence holders on the Bunyip and Tarago rivers is higher than the entitlement volume, but this is allowed under the bulk entitlement as long as the five-year rolling average total does not exceed 6,300 ML.
(2) Opening carryover represents the opening carryover and net spills. Any unused water under this environmental entitlement is available to carry over.

6.17 Yarra basin

The Yarra basin (Figure 6-31) is located in south-east Victoria. The Yarra River originates in the Yarra Ranges National Park and flows through the heart of Melbourne before reaching Port Phillip Bay.

Figure 6-31 Map of the Yarra basin



6.17.1 Management arrangements

Management of water in the Yarra basin is undertaken by various parties, the responsibilities of which Table 6-103 shows.

Table 6-103 Responsibilities for water resources management in the Yarra basin

Authority	Management responsibilities
Melbourne Water	• Manages surface water licensed diversions in the Yarra basin • Provides bulk water to the Melbourne retail water authorities • Manages waterways in the Yarra basin • Operates storages for the Melbourne supply system (1)
Yarra Valley Water	• Supplies the northern and eastern part of the metropolitan Melbourne area including Healesville, Yarra Glen and Warburton from the Greater Yarra system – Thomson River Pool
South East Water	• Supplies the central and eastern part of the metropolitan Melbourne area from the Greater Yarra system – Thomson River Pool
City West Water	• Supplies the western part of the metropolitan Melbourne area from the Greater Yarra system – Thomson River Pool
Western Water	• Supplies the Bulla locality, which is in the basin, with water from both the Greater Yarra system – Thomson River Pool and water from the Maribyrnong basin
Goulburn Valley Water	• Supplies the Wallan locality, which is within the Yarra basin, using water sources from outside the basin
Port Phillip and Westernport Catchment Management Authority	• Responsible for catchment management in the Yarra basin

Note
(1) Melbourne is also supplied from the Thomson, Goulburn and Bunyip basins, as well as from the Victorian Desalination Project.

Melbourne headworks system: Greater Yarra system – Thomson River Pool

Melbourne's water has traditionally been sourced from the Yarra, Thomson, Bunyip and Tarago basins and the Goulburn (Silver and Wallaby creeks) basin. Since the Millennium Drought, major investment in infrastructure has brought other water sources online to support Melbourne's water security. These include the North–South Pipeline, which can bring water from the Goulburn River to be stored in Sugarloaf Reservoir and used to supply Melbourne. However, it can only be used once Melbourne's storage levels fall below 30%. Another major investment has been the Victorian Desalination Project near Wonthaggi.

Surface water sourced from the Yarra, Thomson, Bunyip and Tarago basins and the Goulburn basin (Silver and Wallaby creeks) is known collectively as the Greater Yarra system – Thomson River Pool. This water is also used to provide supplies for regional urban water authorities which are connected to Melbourne (Barwon Water, Western Water, South Gippsland Water and Westernport Water).

Melbourne Water holds the bulk entitlements to surface water in the Thomson River, Yarra River, Tarago River and Silver and Wallaby creeks (Table 6-104), and uses this water to supply the bulk entitlement holders in the Greater Yarra system – Thomson River Pool — City West Water, South East Water, Yarra Valley Water, Barwon Water, South Gippsland Water, Western Water and Westernport Water (Table 6-105). Melbourne Water makes an allocation at the beginning of each month to distribute the available water to entitlement holders according to their entitlement share. In 2017–18, the allocation reached 59.4%.

Volumes of water taken from the river systems to supply the Greater Yarra system – Thomson River Pool are reported in each individual river basin subchapter while the Melbourne retailers' — South East Water, Yarra Valley Water and City West Water — deliveries to customers are accounted for in the distribution system chapter.

Table 6-104 Melbourne Water bulk entitlements to supply the Greater Yarra system – Thomson River Pool

Water entitlements	Annual entitlement volume (ML) (1)
Bulk Entitlement (Yarra River – Melbourne Water) Order 2014	400,000
Bulk Entitlement (Tarago and Bunyip Rivers – Melbourne Water) Order 2014	30,510
Bulk Entitlement (Thomson River – Melbourne Water) Order 2014	171,800
Bulk Entitlement (Silver and Wallaby Creeks – Melbourne Water) Order 2014	22,000
Total entitlement volume	**624,310**

Note

(1) The actual annual entitlement volume Melbourne Water may take is dictated by the cap compliance methodology as stated in its bulk entitlements. Compliance with the long-term average diversion limit of 400,000 ML was assessed for 2017–18 and confirmed using a 15-year rolling average annual diversion. During 2017–18, the Minister for Water approved a new diversion limit compliance method proposed by Melbourne Water as required by its bulk entitlements. Compliance for 2017–18 will be recalculated using the new diversion limit compliance method and reported in the 2018–19 accounts.

Table 6-105 Greater Yarra system – Thomson River Pool bulk entitlements

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (Greater Yarra System-Thomson River Pool – Barwon Water) Order 2014	16,000
Bulk Entitlement (Greater Yarra System-Thomson River Pool – City West Water Limited) Conversion Order 2014	152,797
Bulk Entitlement (Greater Yarra System-Thomson River Pool – South East Water Limited) Conversion Order 2014	206,281
Bulk Entitlement (Greater Yarra System-Thomson River Pool – South Gippsland Water) Order 2014	1,000
Bulk Entitlement (Greater Yarra System-Thomson River Pool – Western Water) Order 2014	18,250
Bulk Entitlement (Greater Yarra System-Thomson River Pool – Westernport Water) Order 2014	1,000
Bulk Entitlement (Greater Yarra System-Thomson River Pool – Yarra Valley Water Limited) Conversion Order 2014	219,776
Total entitlement volume – Greater Yarra System	**615,104**

Victorian Desalination Project

Desalinated seawater from the Victorian Desalination Project near Wonthaggi may be sourced to supplement surface water supplies from the Melbourne Headworks system. The three metropolitan water corporations — City West Water, Yarra Valley Water and South East Water — hold the bulk entitlements to this desalinated seawater. These entitlements are shown in Table 6-106.

In 2017–18, 15,000 ML of water was delivered from the Victorian Desalination Project, and this water was allocated to the three Melbourne retailers in accordance with their bulk entitlements. The volume delivered is included as an inflow into the Yarra basin, as it represents an inflow of water into part of the Melbourne headworks system in the Yarra basin. This can be seen in Table 6-107.

Table 6-106 Desalinated water bulk entitlements

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (Desalinated Water – City West Water Limited) Order 2014	39,595
Bulk Entitlement (Desalinated Water – South East Water Limited) Order 2014	53,454
Bulk Entitlement (Desalinated Water – Yarra Valley Water Limited) Order 2014	56,951
Total entitlement volume – Desalinated water	**150,000**

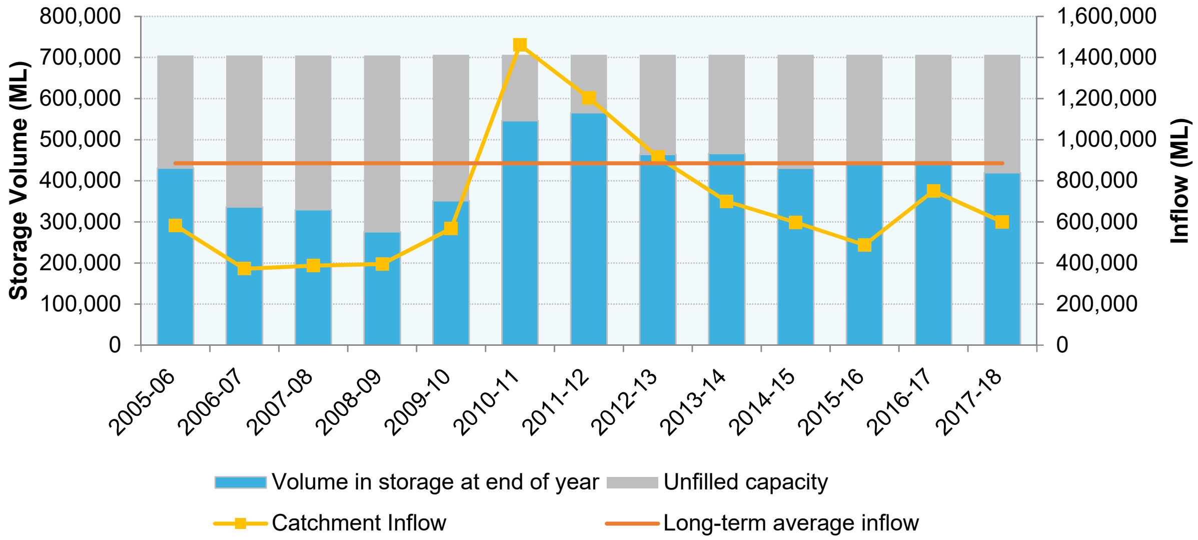
6.17.2 2017–18 Water resource overview

In 2017–18, rainfall in the Yarra basin was between 80% and 100% of the long-term average.

The long-term average used in the 2017–18 accounts has been revised from previous accounts and is now an average of post-1975 streamflow, as chapter 2.2 explains. Catchment inflows were 68% of the long-term average (884,890 ML): less than the inflows recorded in 2016–17, which were 85% of the revised long-term average.

Major storages in the Yarra basin started the year at 64% of capacity and were at 59% at the end of June 2018.

Figure 6-32 Storage volumes and catchment inflows in the Yarra basin



During July 2017, nine of the Yarra basin's unregulated streams remained on diversion restrictions from the previous year. Most were lifted in August 2017, but three streams remained on diversion restrictions for the entirety of 2017–18. Between September 2017 and January 2018, about one-third of all streams were placed under diversion restriction at various intervals. Low rainfall in January 2018 triggered restrictions across the Yarra basin, with bans on licensed diversions implemented for a peak of 18 streams by March 2018. Most streams across the basin remained under bans through until April 2018, and diversion restrictions were removed from seven streams by June 2018. Five streams were subject to diversion restrictions for most of the year: Dixons Creek, McCrae Creek, Pauls Creek, Steels Creek, and lower Stringy Bark Creek.

No urban water-use restrictions were applied in the Yarra basin in 2017–18, with all towns on permanent water-saving rules throughout the year.

Another order for water from the Victorian Desalination Project was made for 2017–18 by the Minister for Water. The total volume delivered to 30 June 2018 was 15,000 ML, representing 0.83% of Melbourne' storage capacity. This is less than the 46,143 ML (or 2.55%) delivered in 2016–17.

In 2017–18, 403,781 ML of water was diverted for consumptive purposes (town, domestic and stock, irrigation and commercial supply). This was less than the 415,134 ML diverted in the previous year. Some of the change from the previous year's diversion is related to the reporting of small catchment dam use, which reduced from 17,346 ML last year to 7,872 ML this year, due to improved hydrological modelling. For more information, see Appendix E.

Water for the environment

Important environmental assets (such as the Australian grayling, river blackfish, Macquarie perch and numerous billabongs and wetlands) depend on water in the Yarra basin. Significant environmental assets include:

- the Yarra River between Warburton and Warrandyte, which has been identified as a Victorian heritage river and depends on water for the environment
- billabongs on the Yarra River floodplain between Millgrove and Yering Gorge as well as on the reach around Banyule Flats near Heidelberg, which support distinct vegetation communities and provide foraging and breeding habitat for waterbirds and frogs.

In 2017–18, water for the environment in the Yarra basin comprised:

- the *Yarra River Environmental Entitlement 2006*, comprising 17,000 ML of high-reliability entitlement and 55 ML of unregulated surface water entitlement held by the VEWH
- water set aside for the environment through the operation of passing flows released as a condition of the *Yarra River Environmental Entitlement 2006*
- water set aside for the environment through the operation of seven streamflow management plans (see chapter 4.2.2)
- water set aside for the environment through the operation of passing flow conditions on licensed diversions

- all other water in the basin not allocated for consumptive use: this water also provides social, recreational and cultural benefits.

In 2017–18, a total of 24,054 ML of environmental water was delivered in-stream in the Yarra basin.

6.17.3 Water balance

The total volumes of water available and supplied from water resources in the Yarra basin in 2017–18 are shown in Table 6-107.

Table 6-107 Water balance – Yarra basin

Water account component	Note	2017–18 (ML)	2016–17 (ML)
Major on-stream storage			
Volume in storage at start of year	1	134,833	138,935
Volume in storage at end of year	1	136,129	134,833
Change in storage		**1,296**	**(4,102)**
Inflows			
Catchment inflow	2	599,650	740,939
Rainfall on major storages	1	11,326	11,359
Transfers from Thomson		133,540	86,383
Inflow of desalinated water		15,000	46,143
Transfers from Goulburn (Silver and Wallaby Creeks)		757	3,058
Transfers from Goulburn via North–South pipeline	3	7	18
Treated wastewater discharged back to river	5	6,735	8,444
Total inflows		**767,015**	**896,344**
Outflows			
Diversions			
Urban diversions	4	389,614	391,588
Licensed diversions from unregulated streams		6,295	6,200
Small catchment dams	6	7,872	17,346
Total diversions		***403,781***	***415,134***
Losses			
Evaporation losses from major storages	1	11,450	10,730
Evaporation from small catchment dams	6	3,542	3,439
In-stream infiltration to groundwater, flows to floodplain and evaporation	7	n/a	n/a
Total losses		***14,992***	***14,169***
Water passed at outlet of basin			
River outflows to Port Phillip Bay		346,945	471,143
Total water passed at outlet of basin		***346,945***	***471,143***
Total outflows		**765,719**	**900,446**

Note
n/a Not applicable.

Notes to the water balance

1. Storages

Major on-stream storages in the Yarra basin are included in the water balance. A breakdown of the volumes presented are in Table 6-108. Volumes in off-stream storages are presented for additional information about the resource condition.

Melbourne Water operates eight major storages within the Yarra basin. Water is harvested by the Upper Yarra, O'Shannassy and Maroondah reservoirs. Sugarloaf and Yan Yean reservoirs are off-stream storages but have dual roles: to harvest water and to act as seasonal balancing reservoirs. Silvan and Greenvale reservoirs are off-stream storages and act as seasonal balancing reservoirs.

Table 6-108 Storage volumes in the Yarra basin

Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Maroondah Reservoir	22,179	8,597	1,923	1,574	3,058	12,004
O'Shannassy Reservoir	3,123	2,541	386	232	(25)	2,670
Upper Yarra Reservoir	200,579	97,243	5,517	4,757	(1,486)	96,517
Yan Yean Reservoir	30,266	26,452	3,500	4,887	(127)	24,938
Total on-stream storages	**256,147**	**134,833**	**11,326**	**11,450**	**1,420**	**136,129**
Off-stream storages						
Cardinia Reservoir	286,911	189,355	8,021	8,193	(19,698)	169,485
Greenvale Reservoir	26,839	22,632	977	2,106	1,443	22,946
Silvan Reservoir	40,445	35,157	2,668	2,556	321	35,590
Sugarloaf Reservoir	96,253	67,018	2,848	3,889	(10,404)	55,573
Total off-stream storages	**450,448**	**314,162**	**14,514**	**16,744**	**(28,338)**	**283,594**
Total storage volumes 2017–18	**706,595**	**448,995**	**25,840**	**28,194**	**(26,918)**	**419,723**
Total storage volumes 2016–17	706,595	443,786	28,757	26,933	3,385	448,995

2. Catchment inflow

Catchment inflow is the balancing item in this water balance. It is the difference between the total outflows, the known inflows and the net change in storage volume.

3. Inter-basin transfers

7 ML of usage was recorded against Yarra Valley Water's Goulburn system bulk entitlement. This water was used to maintain the operational capacity of the North–South Pipeline and keep the pipeline charged for firefighting purposes.

4. Urban diversion correction

The 2016–17 urban diversion volume was incorrectly published in the *Victorian Water Accounts 2016–17* as 402,031 ML. This affected the balancing figure — Catchment inflow — for 2016–17, which was published as 751,382 ML. These volumes have been revised in the table.

5. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-109 lists the wastewater treatment plants in the Yarra basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-109 Volume and use of recycled water in the Yarra basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Aurora	1,495	275	6%	0	87	0	188	0	1,221
Brushy Creek	3,639	710	1%	43	0	0	666	2,929	0
Craigieburn	1,339	538	6%	77	0	0	460	801	0
Healesville	466	99	0%	0	0	0	99	367	0
Kinglake	4	0	0%	0	0	0	0	0	4
Lilydale	2,701	898	4%	102	0	0	796	1,803	0
Monbulk	25	0	0%	0	0	0	0	25	0
Upper Yarra	1,058	319	0%	0	0	0	319	739	0
Wallan	1,026	912	89%	6	903	0	3	72	42
Whittlesea	336	269	69%	70	161	0	38	0	67
Total 2017–18	**12,089**	**4,020**	**33%**	**298**	**1,151**	**0**	**2,569**	**6,736**	**1,334**
Total 2016–17	12,987	3,552	10%	297	1,044	0	2,212	8,444	992

6. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-110 provides information about small catchment dams in the basin.

New hydrological modelling has provided a more-accurate measure of usage and harvested volumes for the 2017–18 reporting period. Therefore, the volumes for small catchment dams in 2016–17 are not directly comparable with the volumes reported for 2017–18. Each year presents the best estimate of the water harvested, used and lost, based on the best information that was available at the time. For more information, see Appendix E and chapter 6.1.2.

Table 6-110 Estimated small catchment dam information for the Yarra basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	17,934	4,965	2,837	7,802
Registered/licensed commercial and irrigation	9,477	2,906	706	3,612
Total 2017–18	**27,412**	**7,872**	**3,542**	**11,414**
Total 2016–17	28,087	17,346	3,438	20,784

7. In-stream losses

An assessment of in-stream infiltration to groundwater, flows to floodplain and evaporation is not made in the Yarra basin as there are no suitable models, and the distribution of streamflow gauges across the basin makes it difficult to estimate in-stream losses (see chapter 6.1.2).

6.17.4 Compliance against entitlements

Compliance against water entitlements is reported in these accounts in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Yarra – Key compliance points
✓ **There was no net increase to the total entitlement volume from the previous year.**
✓ **The total volume diverted (285,666 ML) was within the volume available for the year (479,428 ML).**
✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the Yarra basin provide the basis for how water is shared in the basin. Rights to water in the Yarra basin are outlined in Table 6-111.

Melbourne Water holds a bulk entitlement to divert surface water in the Yarra basin. This entitlement is one of four which contribute to the Greater Yarra system – Thomson River Pool, which primarily supplies Melbourne and supports regional urban water corporations including Barwon Water, Western Water, South Gippsland Water and Westernport Water (Table 6-104 and Table 6-105).

Table 6-111 Entitlement volumes in the Yarra basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Yarra River – Melbourne Water) Order 2014 (1)	400,000
Yarra River Environment Entitlement 2006	
High reliability	17,000
Unregulated surface water	55
Subtotal: Yarra River Environment Entitlement 2006	**17,055**
Take and use licences – unregulated surface water	42,719
Total (30 June 2018)	**459,774**
Total (30 June 2017)	**459,828**

Note

(1) Melbourne Water holds the source bulk entitlement on the Yarra River. The actual annual entitlement volume Melbourne Water may take is dictated by the cap compliance method, as stated in its bulk entitlements. Compliance with the long-term average diversion limit of 400,000 ML was assessed for 2017–18 and confirmed using a 15-year rolling average annual diversion. During 2017–18, the Minister for Water approved a new diversion limit compliance method proposed by Melbourne Water, as required by its bulk entitlements. Compliance for 2017–18 will be recalculated using the new diversion limit compliance method and reported in the 2018–19 Melbourne Water Annual Report This water is used to supply the primary entitlement holders (City West Water, South East Water, Yarra Valley Water, Barwon Water, Western Water, South Gippsland Water and Westernport Water) with entitlement to the Greater Yarra system – Thomson River Pool, which sources water from the Yarra River, Thomson River, Tarago River, Silver Creek and Wallaby Creek.

Table 6-112 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-112 Permitted and actual take for the Yarra basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Yarra River – Melbourne Water [1]	-	400,000	0	**400,000**	**255,317**
Yarra River Environment Entitlement [2]	19,734	17,000	(25)	**36,709**	**24,054**
Take and use licences – unregulated surface water	0	42,773	(54)	**42,719**	**6,295**
Total 2017–18	**19,734**	**459,773**	**(79)**	**479,428**	**285,666**
Total 2016–17	24,278	459,795	(25)	484,048	329,891

Notes

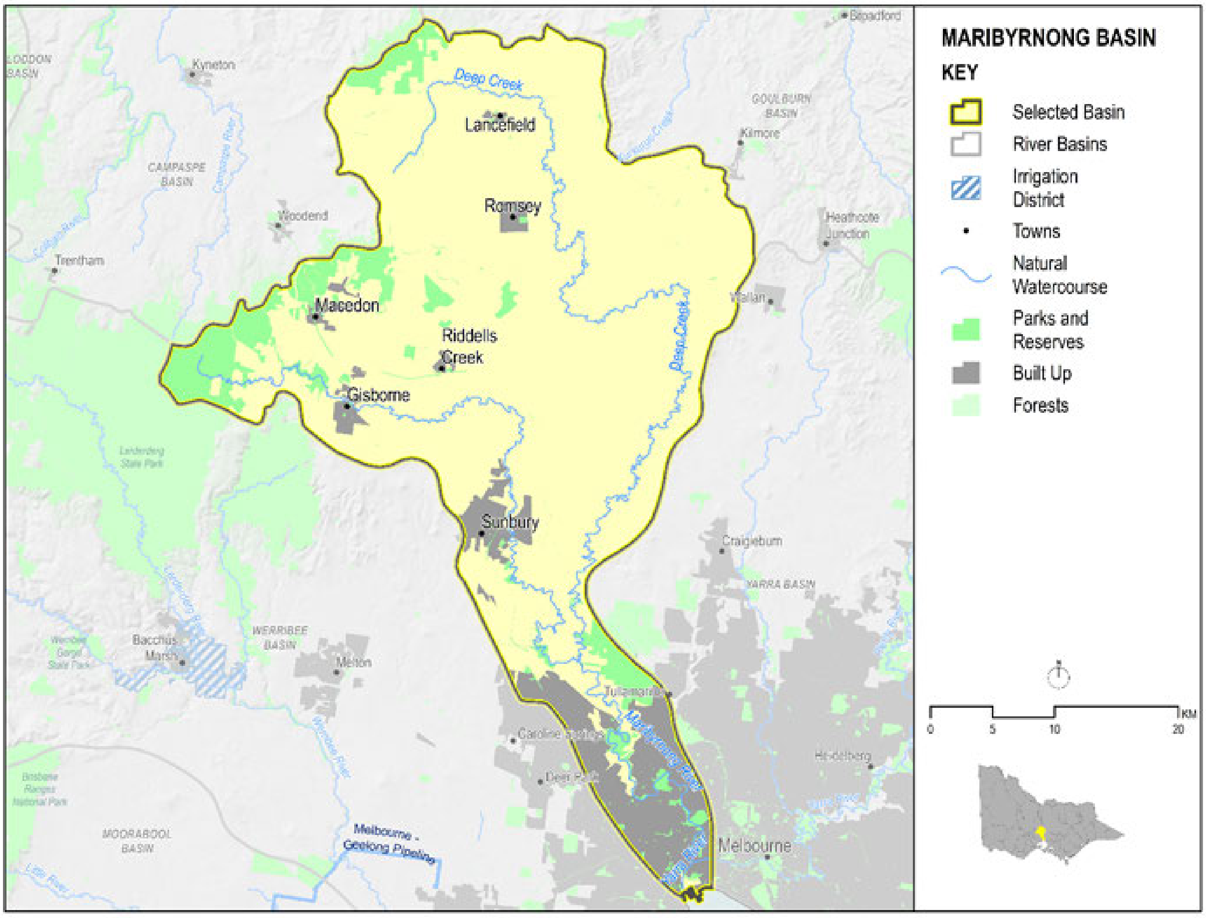
(1) The total available water was assessed for 2017–18 using a 15-year rolling average annual diversion. During 2017–18, the Minister for Water approved a new diversion limit compliance method proposed by Melbourne Water, as required by its bulk entitlements. Compliance for 2017–18 will be recalculated using the new diversion limit compliance method and reported in the 2018–19 accounts.

(2) Water taken under the Yarra environmental entitlement reflects environmental in-stream use. The amount is not included in the water balance in Table 6-107 as it is not an actual diversion from the waterway.

6.18 Maribyrnong basin

The Maribyrnong basin (Figure 6-33) is located north of Melbourne in central Victoria. The headwaters are located near Lancefield and Macedon, and the Maribyrnong River flows through Melbourne before joining the Yarra estuary just upstream of the mouth of the river into Port Phillip Bay.

Figure 6-33 Map of the Maribyrnong basin



6.18.1 Management arrangements

Management of water in the Maribyrnong basin is undertaken by various parties, the responsibilities of which Table 6-113 shows.

Table 6-113 Responsibilities for water resources management in the Maribyrnong basin

Authority	Management responsibilities
Melbourne Water	• Manages surface water licensed diversions in the lower Maribyrnong basin below the confluence of Deep Creek and the Maribyrnong River • Provides bulk water supplies to City West Water and Western Water (from the Greater Yarra system – Thomson River Pool) • Manages waterways, drainage and floodplains in the Maribyrnong basin
City West Water	• Supplies part of metropolitan Melbourne (largely from the Yarra and Thomson basins)
Western Water	• Supplies towns in the basin outside metropolitan Melbourne • Operates Macedon reservoirs
Southern Rural Water	• Manages surface water licensed diversions in the upper Maribyrnong basin and groundwater licensed diversions in the whole of the basin • Operates Rosslynne Reservoir
Port Phillip and Westernport Catchment Management Authority	• Responsible for catchment management in the Maribyrnong basin

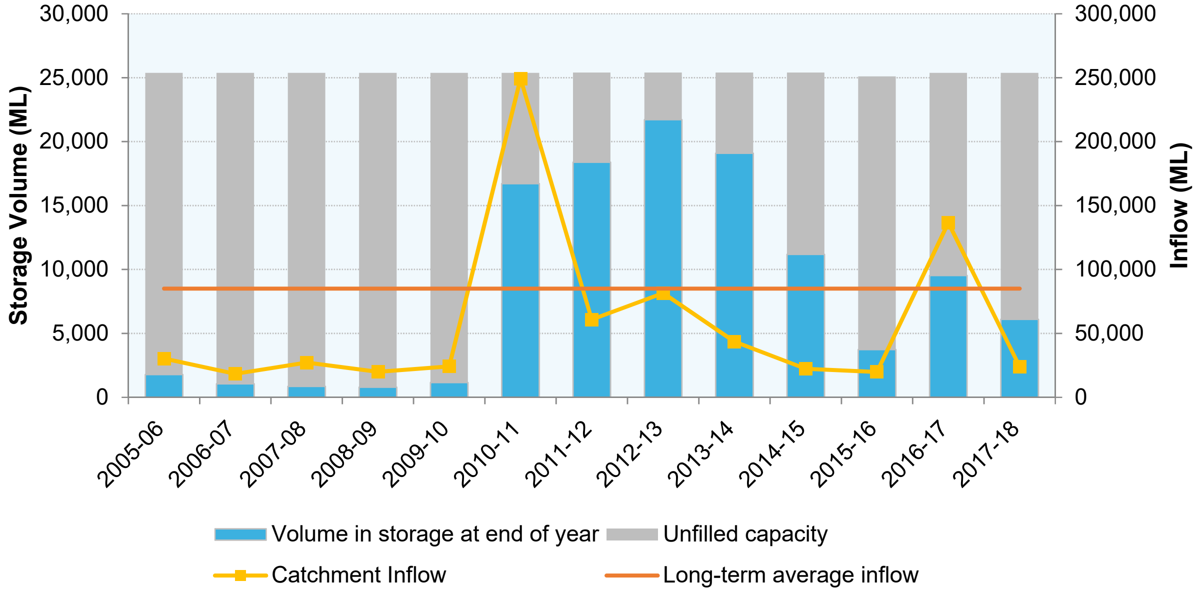
6.18.2 2017–18 Water resource overview

Rainfall across the Maribyrnong basin in 2017–18 was mostly between 80% and 100% of the long-term average, except for a small area in the north-east corner near Lancefield which received between 100% and 125%.

The long-term average used in the 2017–18 accounts has been revised from previous accounts and is now an average of post-1975 streamflow, as chapter 2.2 explains. Catchment inflows were 28% of the revised long-term average annual volume of 85,063 ML: much lower than the inflows recorded in 2016–17, which were 161% of the revised long-term average.

The storage volume in Rosslynne Reservoir started the year at 38% of capacity; it was at 24% of capacity at the end of June 2018.

Figure 6-34 Storage volumes and catchment inflows in the Maribyrnong basin



A licensed diversion ban was in place on the Maribyrnong River for surface water users with winterfill licences for most of the year, except in August and September 2017. Diversions for all-year licences were only banned during the month of December 2017. An additional five unregulated streams had pumping restrictions implemented from January to June 2018: Deep, Emu, Riddles, Turitable and Willimigongon creeks.

No urban water-use restrictions applied in the Maribyrnong basin in 2017–18, with all towns remaining on permanent water-saving rules throughout the year.

In 2017–18, 5,776 ML of water was diverted for consumptive purposes (town, domestic and stock, irrigation and commercial supply). This was less than the 9,959 ML diverted in the previous year. The majority (6,876 ML) of last year's diversion was the reporting of small catchment dam use, which has reduced this year to 2,247 ML, due to improved hydrological modelling. For more information, see Appendix E.

Water for the environment

Important environmental assets (such as the Australian grayling and the Jacksons Creek platypus population) depend on water in the Maribyrnong. The upper Maribyrnong catchment contains areas of intact streamside vegetation, which provide important habitat for native fish including migratory short-finned eels, common and ornate galaxias, flathead gudgeon, tupong and Australian smelt. A large population of waterbugs provides an abundant food source for a significant platypus population in several reaches in the Maribyrnong system.

In 2017–18, water for the environment in the Maribyrnong basin comprised:

- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements held by Western Water and Southern Rural Water
- water set aside for the environment through the operation of passing flow conditions on licensed diversions (regulated and unregulated waterways)
- 300 ML of water traded temporarily from rural customers to the VEWH for release to meet environmental objectives in the Maribyrnong system
- all other water in the basin not allocated for consumptive use: this water also provides social, recreational and cultural benefits.

In 2017–18, a total of 290 ML of environmental water was used in the Maribyrnong basin.

6.18.3 Water balance

The total volumes of water available and supplied from water resources in the Maribyrnong basin in 2017–18 are shown in Table 6-114.

Table 6-114 Water balance – Maribyrnong basin

Water account component	Note	2017–18 (ML)	2016–17 (ML)
Major on-stream storage			
Volume in storage at start of year	1	9,526	3,732
Volume in storage at end of year	1	6,102	9,526
Change in storage		**(3,424)**	**5,794**
Inflows			
Catchment inflow	2	24,064	136,619
Rainfall on major storages	1	716	816
Treated wastewater discharged back to river	3	1,751	2,633
Total inflows		**26,531**	**140,068**
Outflows			
Diversions			
Urban diversions		3,038	2,282
Licensed diversions from regulated streams		426	479
Licensed diversions from unregulated streams		366	321
Small catchment dams	4	2,247	6,876
Total diversions		***6,077***	***9,959***
Losses			
Evaporation losses from major storages	1	903	1,032
Evaporation from small catchment dams	4	1,549	6,678
In-stream infiltration to groundwater, flows to floodplain and evaporation	5	1,971	2,576
Total losses		***4,423***	***10,286***
Water passed at outlet of basin			
River outflows to the Yarra River		19,455	114,030
Total water passed at outlet of basin		***19,455***	***114,030***
Total outflows		**29,955**	**134,274**

Notes to the water balance

1. Storages

Major on-stream storages in the Maribyrnong basin are included in the water balance. A breakdown of the volumes presented are in Table 6-115.

Table 6-115 Storage volumes in the Maribyrnong basin

Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Rosslynne Reservoir	25,368	9,526	716	903	(3,237)	6,102
Total storage volumes 2017–18	**25,368**	**9,526**	**716**	**903**	**(3,237)**	**6,102**
Total storage volumes 2016–17	25,368	3,732	816	1,032	6,010	9,526

2. Catchment inflow

Catchment inflow is the balancing item in this water balance. It is the difference between the total outflows, the known inflows and the net change in storage volume.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-116 lists the wastewater treatment plants in the Maribyrnong basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-116 Volume and use of recycled water in the Maribyrnong basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Gisborne	994	426	8%	67	8	0	351	568	0
Riddells Creek	151	100	66%	7	93	0	0	51	0
Romsey	262	262	100%	19	243	0	0	0	0
Sunbury	4,348	3,216	13%	426	158	0	2,632	1,132	0
Total 2017–18	**5,755**	**4,004**	**70%**	**519**	**502**	**0**	**2,983**	**1,751**	**0**
Total 2016–17	7,046	4,413	14%	390	576	0	3,447	2,633	0

4. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-117 provides information about small catchment dams in the basin.

New hydrological modelling has provided a more-accurate measure of usage and harvested volumes for the 2017–18 reporting period. Therefore, the volumes for small catchment dams in 2016–17 are not directly comparable with the volumes reported for 2017–18. Each year presents the best estimate of the water harvested, used and lost, based on the best information that was available at the time. For more information, see Appendix E and chapter 6.1.2.

Table 6-117 Estimated small catchment dam information for the Maribyrnong basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	10,261	1,906	1,436	3,342
Registered/licensed commercial and irrigation	1,791	341	113	454
Total 2017–18	**12,052**	**2,247**	**1,549**	**3,796**
Total 2016–17	12,435	6,876	6,678	13,554

5. In-stream losses

The method used to estimate in-stream loss in the Maribyrnong basin used in the 2017–18 accounts has been revised from previous accounts, as chapter 6.1.2 explains. This has increased the in-stream loss estimate by 5% for 2017–18: the previous method would have estimated the in-stream loss to be 1,780 ML instead of 1,971 ML.

6.18.4 Compliance against entitlements

Compliance against water entitlements is reported in these accounts in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Maribyrnong – Key compliance points

- ✓ **There was no net increase to the total entitlement volume from the previous year.**
- ✓ **The total volume diverted (3,830 ML) was within the volume available for the year (12,765 ML).**
- ✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
- ✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the Maribyrnong basin provide the basis for how water is shared in the basin. Rights to water in the Maribyrnong basin are outlined in Table 6-118.

Table 6-118 Entitlement volumes in the Maribyrnong basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Gisborne – Barringo Creek) Conversion Order 2004 (1)	585
Bulk Entitlement (Lancefield) Conversion Order 2001	315
Bulk Entitlement (Macedon and Mount Macedon) Conversion Order 2004 (2)	873
Bulk Entitlement (Maribyrnong – Melbourne Water) Conversion Order 2000 (3)	1,396
Bulk Entitlement (Maribyrnong – Southern Rural Water) Conversion Order 2000 (4)	682
Bulk Entitlement (Maribyrnong – Western Water) Conversion Order 2000 (5)	6,100
Bulk Entitlement (Riddells Creek) Conversion Order 2001	300
Bulk Entitlement (Romsey) Conversion Order 2001	460
Take and use licences – unregulated surface water	2,054
Total (30 June 2018)	**12,765**
Total (30 June 2017)	**12,765**

Notes
(1) This entitlement specifies that up to 585 ML can be diverted in any one year. The maximum volume that can be taken over any five-year period is 1,600 ML (320 ML annual average).
(2) This entitlement specifies that up to 873 ML can be diverted in any one year. The maximum volume that can be taken over any five-year period is 3,225 ML (645 ML annual average).
(3) This entitlement supplies water for take and use licences: 1,124 ML of entitlement was allocated for the 2017–18 year.
(4) This entitlement supplies water for take and use licences: 214 ML of entitlement was allocated for the 2017–18 year.
(5) This entitlement specifies that Western Water can take from the waterway up to an annual average of 6,100 ML over any period of five consecutive years.

Table 6-119 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-119 Available water and take for the Maribyrnong basin

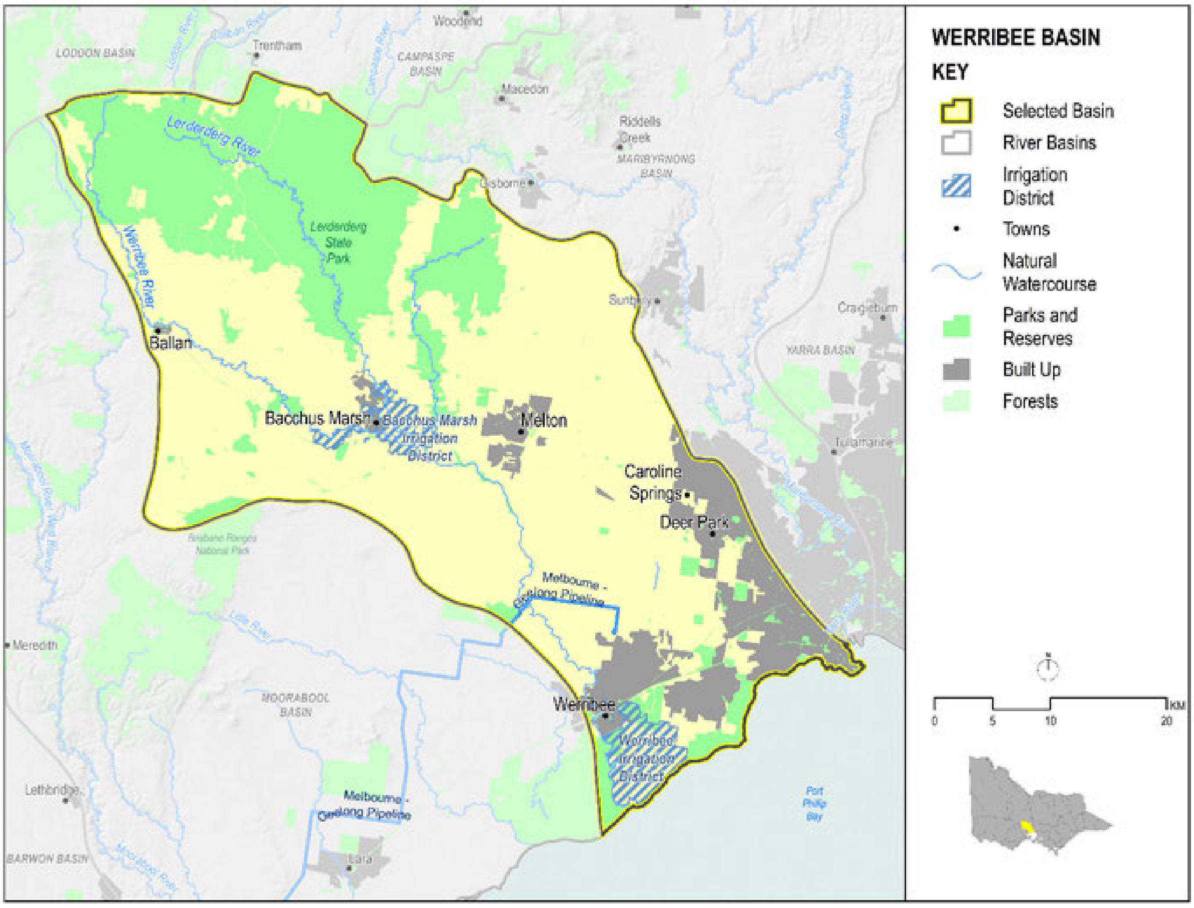
Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Gisborne – Barringo Creek	-	585	0	**585**	**0**
Lancefield	-	315	0	**315**	**152**
Macedon and Mount Macedon	-	873	0	**873**	**361**
Maribyrnong – Melbourne Water (1)	-	1,396	0	**1,396**	**418**
Maribyrnong – Southern Rural Water	-	682	0	**682**	**8**
Maribyrnong – Western Water	-	6,100	0	**6,100**	**2,174**
Riddells Creek	-	300	0	**300**	**17**
Romsey (2)	-	460	0	**460**	**334**
Take and use licences – unregulated surface water	-	2,054	0	**2,054**	**366**
Total 2017–18	**-**	**12,765**	**0**	**12,765**	**3,830**
Total 2016–17	-	12,036	0	12,036	3,083

Notes
(1) Use against the Melbourne Water entitlement includes 290 ML of temporary water purchased by the VEWH from take and use licence holders to be used to provide environmental releases in the Maribyrnong system.
(2) Western Water can use unused allocation of up to 280 ML from a previous year under a drought reserve arrangement. No volume was added to the drought reserve for this entitlement from 2016–17.

6.19 Werribee basin

The Werribee basin (Figure 6-35) is located west of Melbourne. The Werribee and Lerderderg rivers meet upstream of Melton Reservoir and flow through Werribee before entering Port Phillip Bay.

Figure 6-35 Map of the Werribee basin



6.19.1 Management arrangements

Management of water in the Werribee basin is undertaken by various parties, the responsibilities of which Table 6-120 shows.

Table 6-120 Responsibilities for water resources management in the Werribee basin

Authority	Management responsibilities
Southern Rural Water	• Manages Werribee and Bacchus Marsh irrigation districts • Manages licensed diversions • Operates Pykes Creek Reservoir, Melton Reservoir and Merrimu Reservoir
Western Water	• Supplies towns in the north of the basin including Melton and Bacchus Marsh • Operates Djerriwarrh Reservoir
Melbourne Water	• Manages surface water licensed diversions for the lower reaches of Kororoit Creek • Provides bulk water to City West Water and Western Water from the Greater Yarra system – Thomson River Pool • Operates the Western Treatment Plant and supplies recycled water to Southern Rural Water • Manages waterways, drainage and floodplains in all of the Werribee basin
City West Water	• Supplies towns and manages wastewater in metropolitan Melbourne
Central Highlands Water	• Supplies Blackwood and Ballan
Port Phillip and Westernport Catchment Management Authority	• Responsible for waterway and catchment management in the Werribee basin

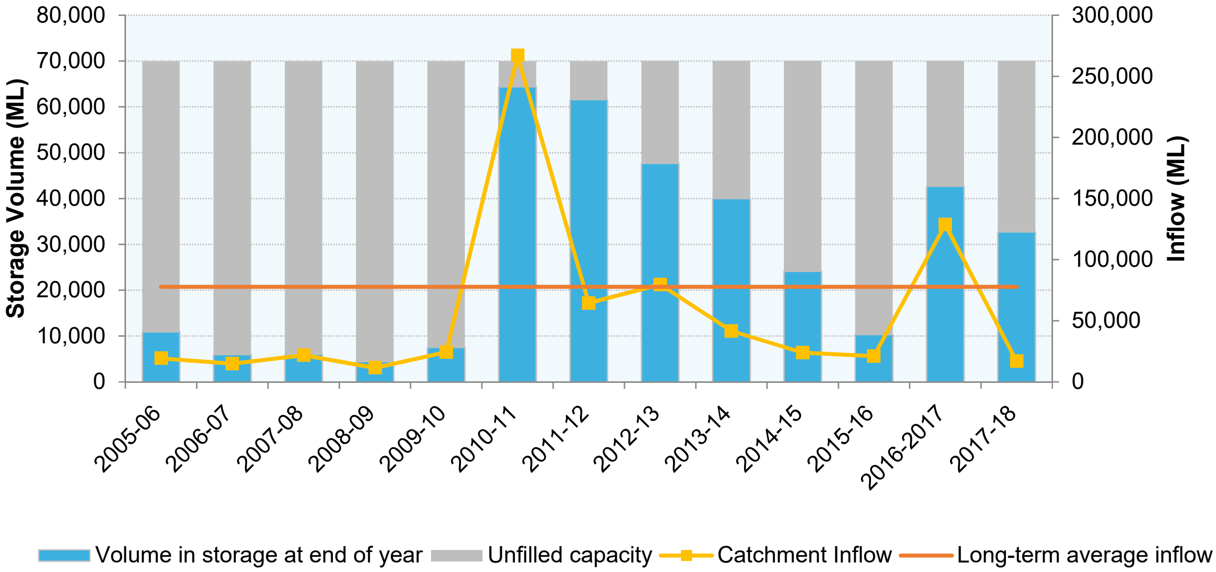
6.19.2 2017–18 Water resource overview

Rainfall across the Werribee basin in 2017–18 was mostly between 80% and 100% of the long-term average, except for a small area in the south-west corner near Lancefield, which received between 60% and 80%.

The long-term average used in the 2017–18 accounts has been revised from previous accounts and is now an average of post-1975 streamflow, as chapter 2.2 explains. Catchment inflows were 22% of the revised long-term average (77,790 ML): much lower than the inflows recorded in 2016–17, which were 165% of the revised long-term average.

Major storages in the Werribee basin started the year at 61% of capacity, and were 47% by the end of June 2018.

Figure 6-36 Storage volumes and catchment inflows in the Werribee basin



In 2017–18, the first seasonal allocation for high-reliability water shares was announced on 7 July 2017 at 5%, which was increased to 45% by December 2017. There were no seasonal allocations for low-reliability water shares in 2017–18.

Low rainfall during summer saw a ban placed on licensed diversions from Lerderderg River in January 2018, which was maintained for the rest of the year. There were restrictions on licensed diversions from Cockatoo and Shepherd Creek for most of the year, with total bans in place in January, February and April 2018.

No urban water-use restrictions applied in the Werribee basin in 2017–18, with all locations on permanent water-saving rules throughout the year.

In 2017–18, 16,112 ML of water was diverted for consumptive purposes (town, domestic and stock, irrigation and commercial supply). This was less than the 20,933 ML diverted in the previous year. Some of the change from the previous year's diversion is related to the reporting of small catchment dam use, which reduced from 5,484 ML last year to 1,144 ML this year, due to improved hydrological modelling. For more information, see Appendix E.

Water for the environment

Important environmental assets (such as the Australian grayling, tupong and red gums) depend on water in the Werribee basin. A highly diverse community of frogs and waterbugs inhabit the upper reaches of the Werribee River, and platypus are present in the lower reaches. The freshwater-saltwater interface of the Werribee River estuary is a regionally significant ecosystem, due to the many aquatic plants and animals it supports and its provision of nursery habitat for juvenile freshwater fish species and estuarine species (such as black bream).

In 2017–18, water for the environment in the Werribee basin comprised:

- the *Werribee River Environmental Entitlement 2011* comprising 10% share of inflows (on average 1,500 ML per year) held by the VEWH
- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements held by Central Highlands Water, Western Water and Southern Rural Water
- water set aside for the environment through the operation of passing flow conditions on licensed diversions (regulated and unregulated waterways)
- all other water in the basin not allocated for consumptive use: this water also provides social, recreational and cultural benefits.

In 2017–18, a total of 2,573 ML of environmental water was delivered in-stream in the Werribee basin.

6.19.3 Water balance

The total volumes of water available and supplied from water resources in the Werribee basin in 2017–18 are shown in Table 6-121.

Table 6-121 Water balance – Werribee basin

Water account component	Note	2017–18 (ML)	2016–17 (ML)
Major on-stream storage			
Volume in storage at start of year	1	42,669	10,341
Volume in storage at end of year	1	32,721	42,699
Change in storage		**(9,948)**	**32,357**
Inflows			
Catchment inflow	2	16,850	128,564
Rainfall on major storages	1	1,642	2,708
Transfers from other basins		0	0
Return flow from irrigation		57	61
Treated wastewater discharged back to river	3	412	411
Total inflows		**18,961**	**131,744**
Outflows			
Diversions			
Urban diversions		2,554	1,668
Irrigation district diversions		12,272	13,551
Licensed diversions from regulated streams		116	221
Licensed diversions from unregulated streams	4	27	8
Small catchment dams		1,144	5,484
Total diversions		***16,112***	***20,933***
Losses			
Evaporation losses from major storages	1	1,587	4,864
Evaporation from small catchment dams	4	940	5,728
In-stream infiltration to groundwater, flows to floodplain and evaporation	5	1,007	6,857
Total losses		***3,534***	***17,449***
Water passed at outlet of basin			
River outflows to Port Phillip Bay		9,263	61,005
Total water passed at outlet of basin		***9,263***	***61,005***
Total outflows		**28,909**	**99,387**

Notes to the water balance

1. Storages

Major on-stream storages in the Werribee basin are included in the water balance. A breakdown of the volumes presented are in Table 6-122.

Table 6-122 Storage volumes in the Werribee basin

Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Djerriwarrh Reservoir	1,014	959	300	159	(338)	762
Melton Reservoir	14,364	7,345	350	0	(4,448)	3,247
Merrimu Reservoir (total)	32,516	16,391	463	1,428	(3,237)	12,189
Pykes Creek Reservoir	22,119	17,974	529	0	(1,980)	16,523
Total storage volumes 2017–18	**70,013**	**42,669**	**1,642**	**1,587**	**(10,003)**	**32,721**
Total storage volumes 2016–17	70,013	10,341	2,708	4,864	34,514	42,699

2. Catchment inflow

Catchment inflow is the balancing item in this water balance. It is the difference between the total outflows, the known inflows and the net change in storage volume.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-123 lists the wastewater treatment plants in the Werribee basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-123 Volume and use of recycled water in the Werribee basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within process		
Altona	5,364	2,319	43%	2,315	0	0	5	0	3,045
Ballan	128	128	100%	0	128	0	0	0	0
Melton	4,920	4,508	84%	490	3,630	0	388	412	0
Parwan (Bacchus Marsh)	585	584	100%	44	540	0	0	0	1
Sunshine Golf Course Sewer Mining Plant	31	31	100%	31	0	0	0	0	0
Western Treatment Plant	173,329	26,548	15%	7	13,197	6,089	50	0	146,781
Total 2017–18	**184,358**	**34,118**	**14%**	**2,887**	**17,495**	**6,089**	**443**	**412**	**149,827**
Total 2016–17	194,750	30,115	13%	8,143	15,904	5,602	466	411	164,224

4. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-124 provides information about small catchment dams in the basin.

New hydrological modelling has provided a more-accurate measure of usage and harvested volumes for the 2017–18 reporting period. Therefore, the volumes for small catchment dams in 2016–17 are not directly comparable with the volumes reported for 2017–18. Each year presents the best estimate of the water harvested, used and lost, based on the best information that was available at the time. For more information, see Appendix E and chapter 6.1.2.

Table 6-124 Estimated small catchment dam information for the Werribee basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	9,038	1,043	897	1,940
Registered/licensed commercial and irrigation	932	101	43	143
Total 2017–18	**9,969**	**1,144**	**940**	**2,084**
Total 2016–17	10,286	5,484	5,728	11,212

5. In-stream losses

The method used to estimate in-stream loss in the Werribee basin in the 2017–18 accounts has been revised from previous accounts, as chapter 6.1.2 explains. This has decreased the in-stream loss estimate by 74% for 2017–18: the previous method would have estimated the in-stream loss to be 3,831 ML instead of 1,007 ML.

6.19.4 Compliance against entitlements

Compliance against water entitlements is reported in these accounts in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Werribee – Key compliance points
✓ **There was no net increase to the total entitlement volume from the previous year.**
✓ **The total volume diverted (17,485 ML) was within the volume available for the year (32,333 ML).**
✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the Werribee basin provide the basis for how water is shared in the basin. Rights to water in the Werribee basin are outlined in Table 6-125.

Entitlements to water in the regulated Werribee system provide for the right to carry over unused allocation to the next season. In the Werribee basin, these entitlement holders can carry over unused water (except for 15% of the unused volume which is deducted for evaporation), and they can hold up to 100% of their entitlement volume. The VEWH holds an environmental entitlement in the Werribee basin, which also enables it to carry over unused water at the end of each year subject to storage capacity and losses. The water available under the entitlement is used to provide environmental flows in the Werribee River and is not diverted out of the waterway.

Table 6-125 Entitlement volumes in the Werribee basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Werribee system – Irrigation) Conversion Order 1997	
High-reliability water shares	15,475
Low-reliability water shares	7,256
Bulk Entitlement (Myrniong) Conversion Order 2004	58
Operating provision	4,251
Subtotal: Bulk Entitlement (Werribee system – Irrigation) Conversion Order 1997	**27,040**
Bulk Entitlement (Ballan) Conversion Order 1998	**451**
Bulk Entitlement (Blackwood and Barry's Reef) Conversion Order 1998	**140**
Bulk Entitlement (Werribee system – Western Water) Conversion Order 2004	**9,986**
Werribee River Environment Entitlement 2011 (1)	**n/a**
Take and use licences – unregulated surface water	**901**
Total (30 June 2018)	**38,518**
Total (30 June 2017)	**38,636**

Note
(1) The *Werribee River Environmental Entitlement 2011* consists of a 10% share of inflows into storage, with the actual volume available in any year varying depending on inflow conditions.
n/a Not applicable.

Table 6-126 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-126 Permitted and actual take for the Werribee basin

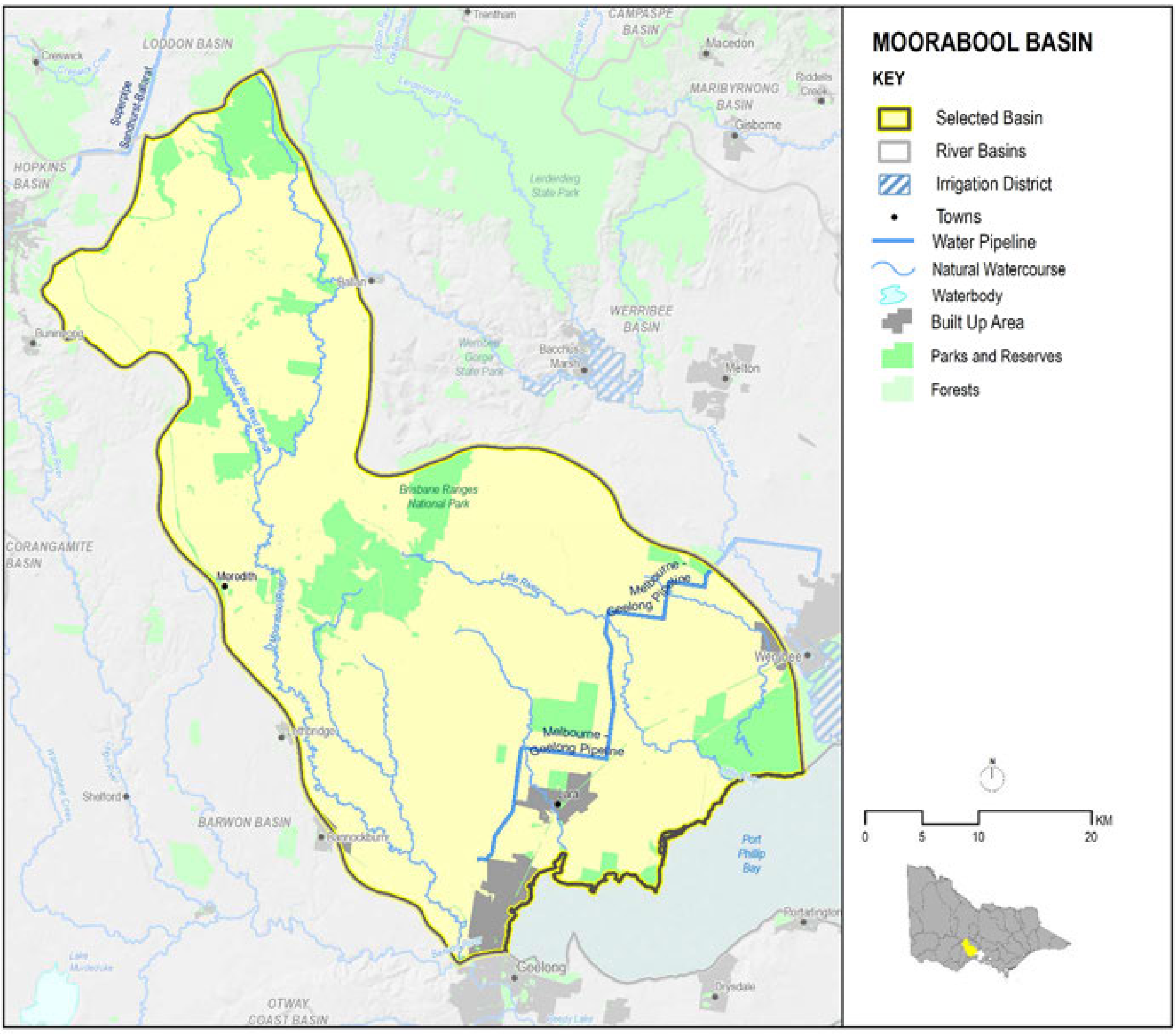
Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Werribee system – Irrigation – Southern Rural Water					
Water shares	10,995	6,337	0	**17,332**	**7,377**
Myrniong	11	47	0	**58**	**55**
Operating provision (1)					**4,954**
Net diversion: Werribee system – Irrigation – Southern Rural Water (2)					**12,386**
Ballan	-	451	0	**451**	**0**
Blackwood and Barry's Reef	-	140	0	**140**	**50**
Werribee system – Western Water	-	9,986	0	**9,986**	**2,449**
Werribee River Environment Entitlement 2011 (3)	2,024	1,510	(186)	**3,348**	**2,573**
Take and use licences – unregulated surface water	-	1,019	0	**1,019**	**27**
Total 2017–18	**13,030**	**19,489**	**(186)**	**32,333**	**17,485**
Total 2016–17	4,866	32,035	0	36,901	17,464

Notes
(1) This reflects use of water to manage the system. It includes any loss incurred in supplying the primary entitlements.
(2) The water use reported in this line item represents the net diversion to supply primary entitlements and fulfil other operating requirements under the Werribee system bulk entitlement (net of return flow from irrigation). It does not include water delivered in-stream for environmental purposes.
(3) Allocation issued reflects the share of inflows available under this entitlement during the year including adjustments made to account for water lost from internal spills, evaporation or changes in storage volume. Water use reported reflects environmental in-stream use: this amount is not reflected in the water balance in Table 6-121 as it is not an actual diversion from the waterway.

6.20 Moorabool basin

The Moorabool basin (Figure 6-37) is located west of Melbourne. The Moorabool River begins as two major tributaries on the southern slopes of the Great Dividing Range near Ballan and flows south-east to join the Barwon River near Geelong. The Moorabool basin also includes Little River, which flows into Port Phillip Bay.

Figure 6-37 Map of the Moorabool basin



6.20.1 Management arrangements

Management of water in the Moorabool basin is undertaken by various parties, the responsibilities of which Table 6-127 shows.

Table 6-127 Responsibilities for water resources management in the Moorabool basin

Authority	Management responsibilities
Southern Rural Water	• Manages licensed diversions
Barwon Water	• Supplies Geelong and surrounding towns (mainly sourced from the Barwon basin) • Manages reservoirs on the east Moorabool River and has a third of the share of Lal Lal Reservoir on the west Moorabool River • Manages Stony Creek Reservoir on Stony Creek
Central Highlands Water	• Supplies Ballarat and surrounding towns (sourced from both the Barwon and Moorabool basins) • Manages reservoirs on the west Moorabool River and has two-thirds of the share of Lal Lal Reservoir
Corangamite Catchment Management Authority	• Responsible for waterway and catchment management in the Moorabool basin

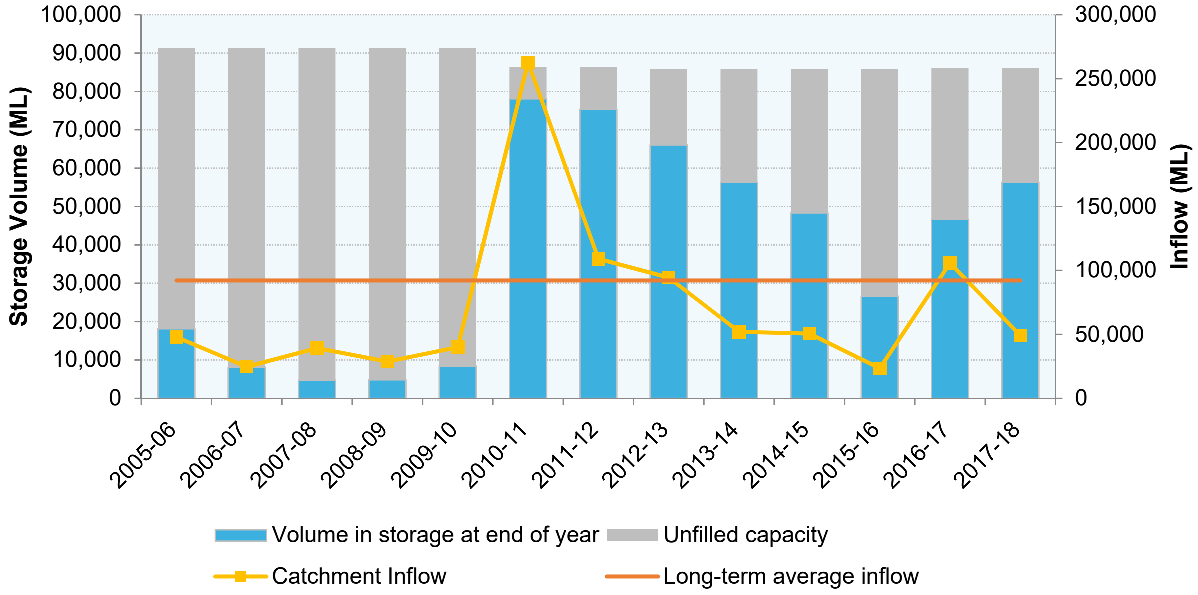
6.20.2 2017–18 Water resource overview

Rainfall across the centre of the Moorabool basin in 2017–18 was between 60% and 80% of the long-term average. The north-west (above Meredith to the basin boundary), the south-east (from Lara to Port Phillip Bay) and an area above the Brisbane Ranges National Park received between 80% and 100%.

The long-term average used in the 2017–18 accounts has been revised from previous accounts and is now an average of post-1975 streamflow, as chapter 2.2 explains. Catchment inflows were 53% of the revised long-term average annual volume of 92,180 ML: less than the inflows recorded in 2016–17, which were 115% of the revised long-term average.

Storage levels for the major storages in the basin started the year at 54% of capacity and held 65% at the end of June 2018.

Figure 6-38 Storage volumes and catchment inflows in the Moorabool basin



The Moorabool River was the only unregulated stream placed on restriction within the Moorabool basin during 2017–2018. Low rainfall triggered stage 3 restrictions in November and December 2017:; this was upgraded to a ban on licensed diversions from January until May 2018.

No urban water-use restrictions applied in the Moorabool basin in 2017–18, with all towns remaining on permanent water-saving rules throughout the year.

In 2017–18, 18,080 ML of water was diverted for consumptive purposes (town, domestic and stock, irrigation and commercial supply). This was less than the 29,101 ML diverted in the previous year. Some of the change from the previous year's diversion is related to the reporting of small catchment dam use, which reduced from 13,012 ML last year to only 3,127 ML this year, due to improved hydrological modelling. For more information, see Appendix E.

Water for the environment

Important environmental assets (such as river blackfish) between Lal Lal Reservoir and She Oaks Weir, as well as the lower Barwon Wetlands (which is part of the Port Phillip Bay and Bellarine Peninsula Ramsar Site) depend on water in the Moorabool basin. The system contains extensive areas of endangered remnant vegetation including streambank shrubland and riparian woodland ecological vegetation communities. Platypus, water rats and a range of waterbugs are also present.

In 2017–18, water for the environment in the Moorabool basin comprised:

- the *Moorabool River Environmental Entitlement 2010* comprising 11.9% of inflows held by the VEWH
- 3,521 ML of treated groundwater discharged from the Fyansford quarry to the lower Moorabool River
- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements held by Central Highlands Water and Barwon Water and the VEWH's *Moorabool River Environmental Entitlement 2010*
- water set aside for the environment through the operation of passing flow conditions on licensed diversions
- all other water in the basin not allocated for consumptive use: this water also provides social, recreational and cultural benefits.

In 2017–18, a total of 6,267 ML of environmental water was delivered in-stream in the Moorabool basin.

6.20.3 Water balance

The total volumes of water available and supplied from water resources in the Moorabool basin in 2017–18 are shown in Table 6-128.

Table 6-128 Water balance – Moorabool basin

Water account component	Note	2017–18 (ML)	2016–17 (ML)
Major on-stream storage			
Volume in storage at start of year	1	41,209	22,689
Volume in storage at end of year	1	51,355	41,209
Change in storage		**10,146**	**18,520**
Inflows			
Catchment inflow	2	49,122	105,837
Rainfall on major storages	1	3,498	5,497
Treated wastewater discharged back to river	3	0	0
Total inflows		**52,620**	**111,334**
Outflows			
Diversions			
Urban diversions	4	10,220	8,879
Transfers to Barwon basin (White Swan Reservoir)	4	3,389	6,211
Licensed diversions from unregulated streams		1,344	1,000
Small catchment dams	5	3,127	13,012
Total diversions		***18,080***	***29,101***
Losses			
Evaporation losses from major storages	1	6,683	5,885
Evaporation from small catchment dams	5	1,839	8,233
In-stream infiltration to groundwater, flows to floodplain and evaporation	6	7,594	5,391
Total losses		***16,115***	***19,508***
Water passed at outlet of basin			
River outflows to Port Phillip Bay (Little River) and other small coastal streams		1,788	9,634
River outflows to the Barwon River (Moorabool River)		6,491	34,571
Total water passed at outlet of basin		***8,279***	***44,205***
Total outflows		**42,473**	**92,814**

Notes to the water balance

1. Storages

Only major on-stream storages in the Moorabool basin are included in the water balance. A breakdown of the volumes presented are in Table 6-129. Volumes in off-stream storages are presented for additional information about the resource condition.

Table 6-129 Storage volumes in the Moorabool basin

Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML) (1)	Evaporation (ML) (2)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Bostock Reservoir	7,455	4,359	407	799	(971)	2,996
Korweinguboora Reservoir	2,327	1,032	116	109	(1,024)	15
Lal Lal Reservoir	59,549	31,387	1,936	4,199	16,454	45,578
Moorabool Reservoir	6,192	4,341	996	1,489	(1,115)	2,733
Wilsons Reservoir	1,010	90	43	87	(13)	33
Total on-stream storages	**76,533**	**41,209**	**3,498**	**6,683**	**13,331**	**51,355**
Off-stream storage						
Upper Stony Creek Reservoir	9,494	5,420	n/a	n/a	(446)	4,974
Total off-stream storage	**9,494**	**5,420**	**n/a**	**n/a**	**(446)**	**4,974**
Total storage volumes 2017–18	**86,027**	**46,629**	**3,498**	**6,683**	**12,885**	**56,329**
Total storage volumes 2016–17	86,027	26,612	5,497	5,885	20,404	46,629

2. Catchment inflow

Catchment inflow is the balancing item in this water balance. It is the difference between the total outflows, the known inflows and the net change in storage volume.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-130 lists the wastewater treatment plants in the Moorabool basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-130 Volume and use of recycled water in the Moorabool basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Gordon	21	21	100%	0	21	0	0	0	0
Northern Water Reclamation Plant	1,324	1,324	95%	1,256	0	0	68	0	0
Total 2017–18	**1,345**	**1,345**	**100%**	**1,256**	**21**	**0**	**68**	**0**	**0**
Total 2016–17	1,287	1,271	94%	1,198	14	0	59	0	16

4. Inter-basin transfers

The 3,389 ML transfer represents water transferred to White Swan Reservoir in the Barwon basin before being supplied to urban customers in the Ballarat area, which is located within both the Barwon and Moorabool basins.

5. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-131 provides information about small catchment dams in the basin.

New hydrological modelling has provided a more-accurate measure of usage and harvested volumes for the 2017–18 reporting period. Therefore, the volumes for small catchment dams in 2016–17 are not directly comparable with the volumes reported for 2017–18. Each year presents the best estimate of the water harvested, used and lost, based on the best information that was available at the time. For more information, see Appendix E and chapter 6.1.2.

Table 6-131 Estimated small catchment dam information for the Moorabool basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	13,067	1,978	1,457	3,435
Registered/licensed commercial and irrigation	7,259	1,149	382	1,531
Total 2017–18	**20,326**	**3,127**	**1,839**	**4,966**
Total 2016–17	20,828	13,012	8,233	21,245

6. In-stream losses

The method used to estimate in-stream loss in the Moorabool basin in the 2017–18 accounts has been revised from previous accounts, see chapter 6.1.2 for discussion. This has increased the in-stream loss estimate by 5% for 2017–18: the previous method would have estimated the in-stream loss to be 7,205 ML instead of 7,594 ML.

6.20.4 Compliance against entitlements

Compliance against water entitlements is reported in these accounts in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Moorabool – Key compliance points

- ✓ **There was a net increase in the total entitlement volume of 6 ML, due to the permanent transfer of a take and use licence that changed the characteristics such that the additional volume is now reported in the accounts.**
- ✓ **Total volume diverted (17,698 ML) was within the volume available for the year (49,581 ML)**
- ✓ **No individual bulk entitlement holder took more than the annual volume made available to them**

✓	**Individual bulk entitlement holders complied with all provisions in their entitlements**

Entitlements in the Moorabool basin provide the basis for how water is shared in the basin. Rights to water in the Moorabool basin are outlined in Table 6-132.

The VEWH holds an environmental entitlement in the Moorabool basin, but the water available under the entitlement is used to support streamflows and is not diverted out of the waterway. As this water use is not a diversion from the waterway, it has not been included as part of the water balance diversions in Table 6-128.

Table 6-132 Entitlement volumes in the Moorabool basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Lal Lal – Barwon) Conversion Order 1995 (1)	5,925
Bulk Entitlement (Lal Lal – Central Highlands) Conversion Order 1995 (2)	12,575
Moorabool River Environment Entitlement 2010 (3)	n/a
Bulk Entitlement (Meredith) Conversion Order 1995	600
Bulk Entitlement (She Oaks) Conversion Order 1995 (4)	2,000
Bulk Entitlement (Upper East Moorabool System) Conversion Order 1995	9,000
Bulk Entitlement (Upper West Moorabool System) Conversion Order 1995	10,500
Take and use licences – unregulated surface water	3,573
Total (30 June 2018)	**44,173**
Total (30 June 2017)	**44,167**

Notes

(1) Under this entitlement, the authority may take up to a total of 5,925 ML in any one year and up to 17,775 ML in any consecutive three-year period.

(2) Under this entitlement, the authority may take up to a total of 12,575 ML in any one year and up to 37,725 ML in any consecutive three-year period.

(3) The *Moorabool River Environmental Entitlement 2010* consists of an 11.9% share of inflows into storage, up to 7,500 ML every three years, with the actual volume available in any year varying depending on inflow conditions.

(4) Under this entitlement, the authority may take up to 6,000 ML in any three consecutive years.

n/a Not applicable.

Table 6-133 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-133 Available water and take for the Moorabool basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Lal Lal – Barwon	-	5,925	0	**5,925**	**1,816**
Lal Lal – Central Highlands	-	12,575	0	**12,575**	**5,365**
Moorabool River Environment Entitlement (1)	4,923	0	485	**5,408**	**2,746**
Meredith	-	600	0	**600**	**0**
She Oaks	-	2,000	0	**2,000**	**0**
Upper East Moorabool system	-	9,000	0	**9,000**	**3,039**
Upper West Moorabool system	-	10,500	0	**10,500**	**3,389**
Take and use licences – unregulated surface water	-	3,567	6	**3,573**	**1,344**
Total 2017–18	**4,923**	**44,167**	**491**	**49,581**	**17,698**
Total 2016–17	730	50,329	0	51,059	18,055

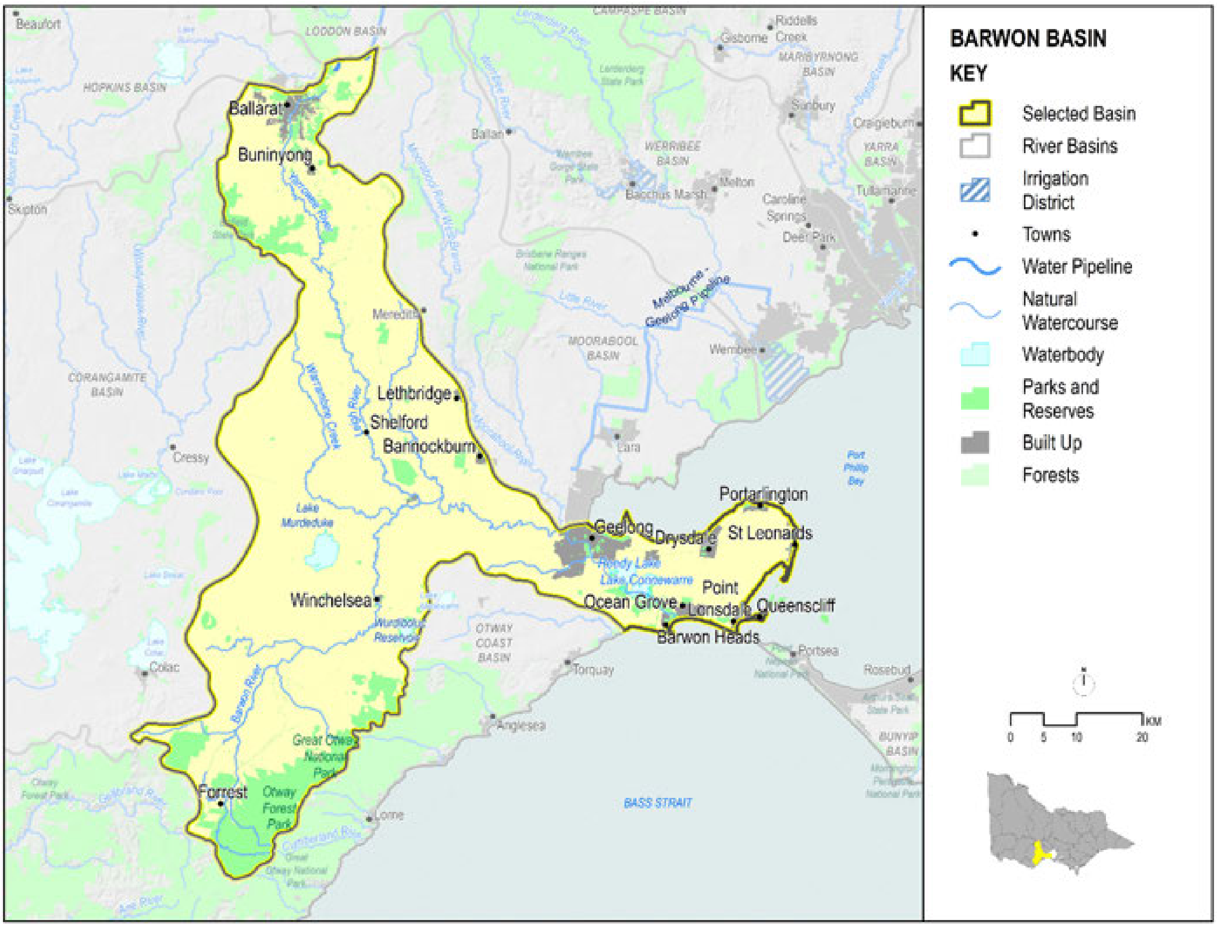
Note

(1) ‘Water taken’ reported reflects environmental in-stream use: this amount is not included in the water balance in Table 6-128, as it is not an actual diversion from the waterway. Unused water is available to carry over under this entitlement.

6.21 Barwon basin

The Barwon basin (Figure 6-39) is located in western Victoria. The Barwon River originates in the Otway Ranges and receives inflows from the north from the Leigh River and the Moorabool River before it flows into the ocean at Barwon Heads.

Figure 6-39 Map of the Barwon basin



6.21.1 Management arrangements

Management of water in the Barwon basin is undertaken by various parties, the responsibilities of which Table 6-134 shows.

Table 6-134 Responsibilities for water resources management in the Barwon basin

Authority	Management responsibilities
Southern Rural Water	• Manages licensed diversions
Barwon Water	• Supplies Geelong and surrounding towns, also by sourcing water from the Moorabool basin and from the Melbourne system via the Melbourne to Geelong Pipeline • Operates West Barwon Reservoir and Lake Wurdee Boluc
Central Highlands Water	• Supplies Ballarat and surrounding towns, mainly with water sourced from the Moorabool basin and the Campaspe and Goulburn basins via the Goldfields Superpipe • Operates White Swan and Gong Gong reservoirs
Corangamite Catchment Management Authority	• Responsible for waterway and catchment management in the whole of the Barwon basin

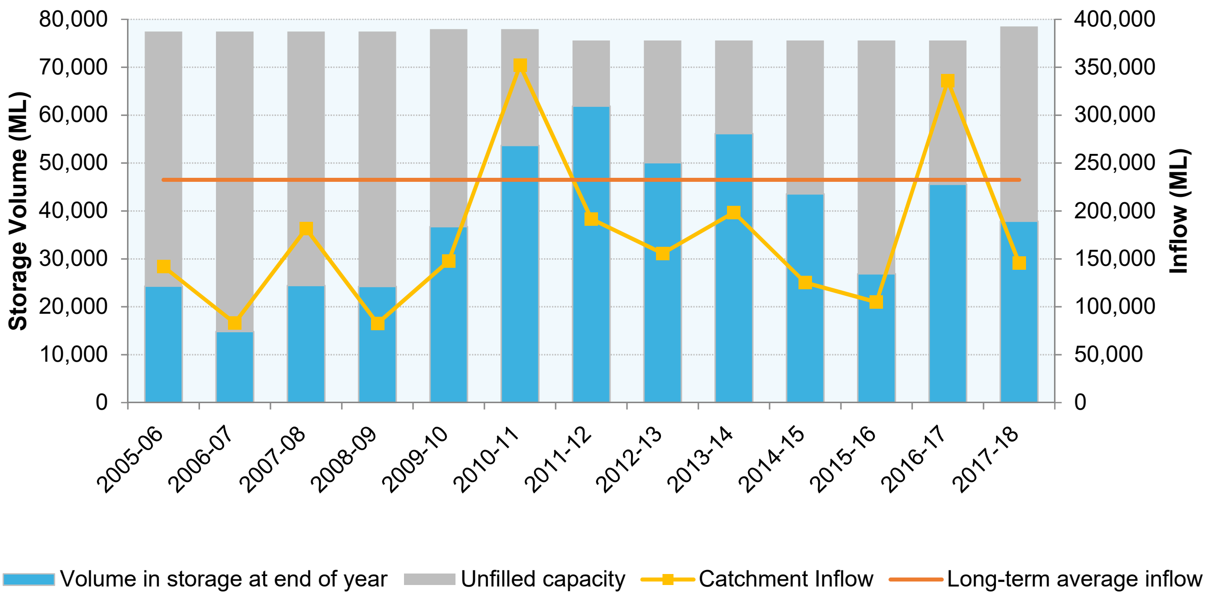
6.21.2 2017–18 Water resource overview

Rainfall in the Barwon basin in 2017–18 was mostly between 60% and 80% of the long-term average, with the south-eastern (from Geelong to St Leonards) and northern parts of the basin receiving between 80% and 100% of the long-term average.

The long-term average used in the 2017–18 accounts has been revised from previous accounts and is now an average of post-1975 streamflow, as chapter 2.2 explains. Catchment inflows in the Barwon basin in 2017–18 were 63% of the revised long-term average (232,508 ML): less than the inflows recorded in 2016–17, which were 144% of the revised long-term average.

Storage levels in the Barwon basin started the year at 58% and ended the year at 48% of total capacity.

Figure 6-40 Storage volumes and catchment inflows in the Barwon basin



The Barwon River remained unrestricted from July to December 2017. Low rainfall during summer resulted in bans on licensed diversions in January 2018 at the Inverleigh, Pollocks ford and Ricketts Marsh sections of the Barwon River. These bans were maintained for five months before being lifted in June 2018.

No urban water-use restrictions applied in the Barwon basin in 2017–18, with all towns on permanent water-saving rules throughout the year.

In 2017–18, 44,372 ML of water was diverted for consumptive purposes (town, domestic and stock, irrigation and commercial supply). This was less than the 65,320 ML diverted in the previous year. Some of the change from the previous year's diversion is related to the reporting of small catchment dam use, which reduced from 20,793 ML last year to only 4,785 ML this year, due to improved hydrological modelling. For more information, see Appendix E.

Water for the environment

The Bellarine Peninsula contains internationally significant wetlands listed under the Ramsar Convention which rely on freshwater inputs from the Barwon basin to maintain good ecological function. Other important environmental assets include the Lake Connewarre complex, native fish populations (such as Australian grayling and Yarra pygmy perch, Australian mudfish and tupong), the native waterbird population (particularly migratory shorebirds including the common greenshank, Pacific golden plover, curlew sandpiper and red-necked stint), and platypus populations in the upper and middle catchment.

In 2017–18, water for the environment in the Barwon basin comprised:

- the Barwon River Environmental Entitlement 2011
- the Upper Barwon River Environmental Entitlement 2018, a new entitlement established on 4 April 2018
- water from the Ballarat South Wastewater Treatment Plant released into the Leigh and Barwon rivers
- a portion of the treated groundwater discharged from the Fyansford quarry to the lower Moorabool River
- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements held by Barwon Water and Central Highlands Water
- water set aside for the environment through the operation of passing flow conditions on licensed diversions
- all other water in the basin not allocated for consumptive use: this water also provides social, recreational and cultural benefits.

6.21.3 Water balance

The total volumes of water available and supplied from water resources in the Barwon basin in 2017–18 are shown in Table 6-135.

Table 6-135 Water balance – Barwon basin

Water account component	Note	2017–18 (ML)	2016–17 (ML)
Major on-stream storage			
Volume in storage at start of year	1	22,627	12,967
Volume in storage at end of year	1	18,345	22,627
Change in storage		**(4,282)**	**9,660**
Inflows			
Catchment inflow	2	145,604	335,884
Rainfall on major storages	1	2,253	3,477
Inflows from the Moorabool River		6,491	34,571
Transfers from the Corangamite basin via Woady Yaloak Channel		0	0
Transfers from Moorabool basin to White Swan Reservoir	3	3,389	6,211
Transfers from Campaspe basin to White Swan Reservoir		0	1,359
Treated wastewater discharged back to river	4	9,440	11,072
Total inflows		**167,177**	**392,574**
Outflows			
Diversions			
Urban diversions		38,559	43,314
Licensed diversions from unregulated streams		1,028	1,213
Small catchment dams	5	4,785	20,793
Total diversions		***44,372***	***65,320***
Losses			
Evaporation losses from major storages	1	3,089	1,871
Evaporation from small catchment dams	5	3,300	15,883
In-stream infiltration to groundwater, flows to floodplain and evaporation	6	11,745	10,457
Total losses		***18,135***	***28,211***
Water passed at outlet of basin			
River outflows to the ocean		108,953	289,383
Total water passed at outlet of basin		***108,953***	***289,383***
Total outflows		**171,459**	**382,914**

Notes to the water balance

1. Storages

Major on-stream storages in the Barwon basin are included in the water balance. A breakdown of the volumes presented are in Table 6-136. Volumes in off-stream storages are presented for additional information about the resource condition.

Storage levels for all major storages in the basin started the year at 45,567 ML in July 2017 and were 37,867 ML (48% of capacity) at the end of June 2018.

Table 6-136 Storage volumes in the Barwon basin

Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Gong Gong Reservoir	1,902	1,524	144	206	(111)	1,351
West Barwon Reservoir (1)	22,064	8,806	1,226	1,581	(1,715)	6,736
White Swan Reservoir (2)	14,107	12,297	883	1,302	(1,620)	10,258
Total on-stream storages	**38,073**	**22,627**	**2,253**	**3,089**	**(3,446)**	**18,345**
Off-stream storage						
Wurdee Boluc Reservoir (3)	40,431	22,940	n/a	n/a	(3,418)	19,522
Total off-stream storage	**40,431**	**22,940**	**n/a**	**n/a**	**(3,418)**	**19,522**
Total storage volumes 2017–18	**78,504**	**45,567**	**2,253**	**3,089**	**(6,864)**	**37,867**
Total storage volumes 2016–17	77,944	26,897	3,477	1,871	17,064	45,567

Notes
(1) Total capacity includes dead storage volume of 560 ML.
(2) White Swan Reservoir is treated as an on-stream storage for the purpose of the water balance.
(3) Total capacity includes dead storage volume of 2,077 ML.
n/a Not applicable.

2. Catchment inflow

Catchment inflow is the balancing item in this water balance. It is the difference between the total outflows, the known inflows and the net change in storage volume.

3. Transfer of water

The 3,389 ML transfer represents water that is transferred to White Swan Reservoir from the Moorabool basin. This water is used to supply urban customers in the Ballarat area, which is located within both the Barwon and Moorabool basins.

4. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-137 lists the wastewater treatment plants in the Barwon basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Barwon Water and Central Highlands Water operate treatment plants within the Barwon basin. Overall, 10% of wastewater was recycled in 2017–18, a slight decrease on 10% from 2016–17.

Table 6-137 Volume and use of recycled water in the Barwon basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Ballarat North	2,712	455	9%	19	0	232	204	2,257	0
Ballarat South	7,301	118	0%	0	0	0	118	7,183	0
Bannockburn	218	218	56%	0	122	0	96	0	0
Birregurra	16	16	0%	0	0	0	16	0	0
Black Rock	23,940	2,317	10%	947	1,371	0	0	0	21,623
Portarlington	409	409	37%	0	152	0	257	0	0
Winchelsea	51	51	8%	0	4	0	47	0	0
Total 2017–18	**34,647**	**3,584**	**10%**	**966**	**1,649**	**232**	**738**	**9,440**	**21,623**
Total 2016–17	33,881	3,198	7%	935	1,263	147	854	11,072	19,610

5. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-138 provides information about small catchment dams in the basin.

New hydrological modelling has provided a more-accurate measure of usage and harvested volumes for the 2017–18 reporting period. Therefore, the volumes for small catchment dams in 2016–17 are not directly comparable with the volumes reported for 2017–18. Each year presents the best estimate of the water harvested, used and lost, based on the best information that was available at the time. For more information, see Appendix E and chapter 6.1.2.

Table 6-138 Estimated small catchment dam information for the Barwon basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	24,020	3,417	2,803	6,220
Registered/licensed commercial and irrigation	9,889	1,368	498	1,865
Total 2017–18	**33,909**	**4,785**	**3,300**	**8,085**
Total 2016–17	34,600	20,793	15,883	36,676

6. In-stream losses

The method used to estimate in-stream loss in the Barwon basin in the 2017–18 accounts has been revised from previous accounts, as chapter 6.1.2 explains. This has increased the in-stream loss estimate by 6% for 2017–18: the previous method would have estimated the in-stream loss to be 11,034 ML instead of 11,745 ML.

6.21.4 Compliance against entitlements

Compliance against water entitlements is reported in these accounts in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year

- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Barwon – Key compliance points
✓ **There was no net increase to the total entitlement volume from the previous year.**
✓ **The total volume diverted (39,587 ML) was within the volume available for the year (61,238 ML).**
✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the Barwon basin provide the basis for how water is shared in the basin. Rights to water in the Barwon basin are outlined in Table 6-139.

The *Barwon River Environmental Entitlement 2011* allows unregulated flows to be diverted to floodplain wetlands. The volume of unregulated flows available for diversion varies, depending on seasonal conditions. No volumetric use gets recorded against this entitlement.

Table 6-139 Entitlement volumes in the Barwon basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlements (Upper Barwon System) Conversion Order 2002 (1)	42,466
Bulk Entitlement (Yarrowee-White Swan System) Conversion Order 2002 (2)	12,267
Barwon River Environmental Entitlement 2011 (3)	n/a
Upper Barwon River Environmental Entitlement 2018(4)	n/a
Take and use licences – unregulated surface water	5,508
Total (30 June 2018)	**60,241**
Total (30 June 2017)	**61,243**

Notes
(1) This entitlement specifies that the authority may take up to 127,400 in any successive three-year period.
(2) This entitlement specifies that the authority may take up to 36,800 in any successive three-year period, it includes up to 10,500 ML extracted from the Upper West Moorabool system under Central Highlands Water's Upper West Moorabool bulk entitlement in the Moorabool basin.
(3) Use of this entitlement depends on suitable river heights as specified in the entitlement.
(4) The *Upper Barwon River Environmental Entitlement 2018* consists of a 3.8% share of inflows into storage, with the actual volume available in any year varying, depending on inflow conditions.
n/a Not applicable.

Table 6-140 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-140 Available water and take for the Barwon basin

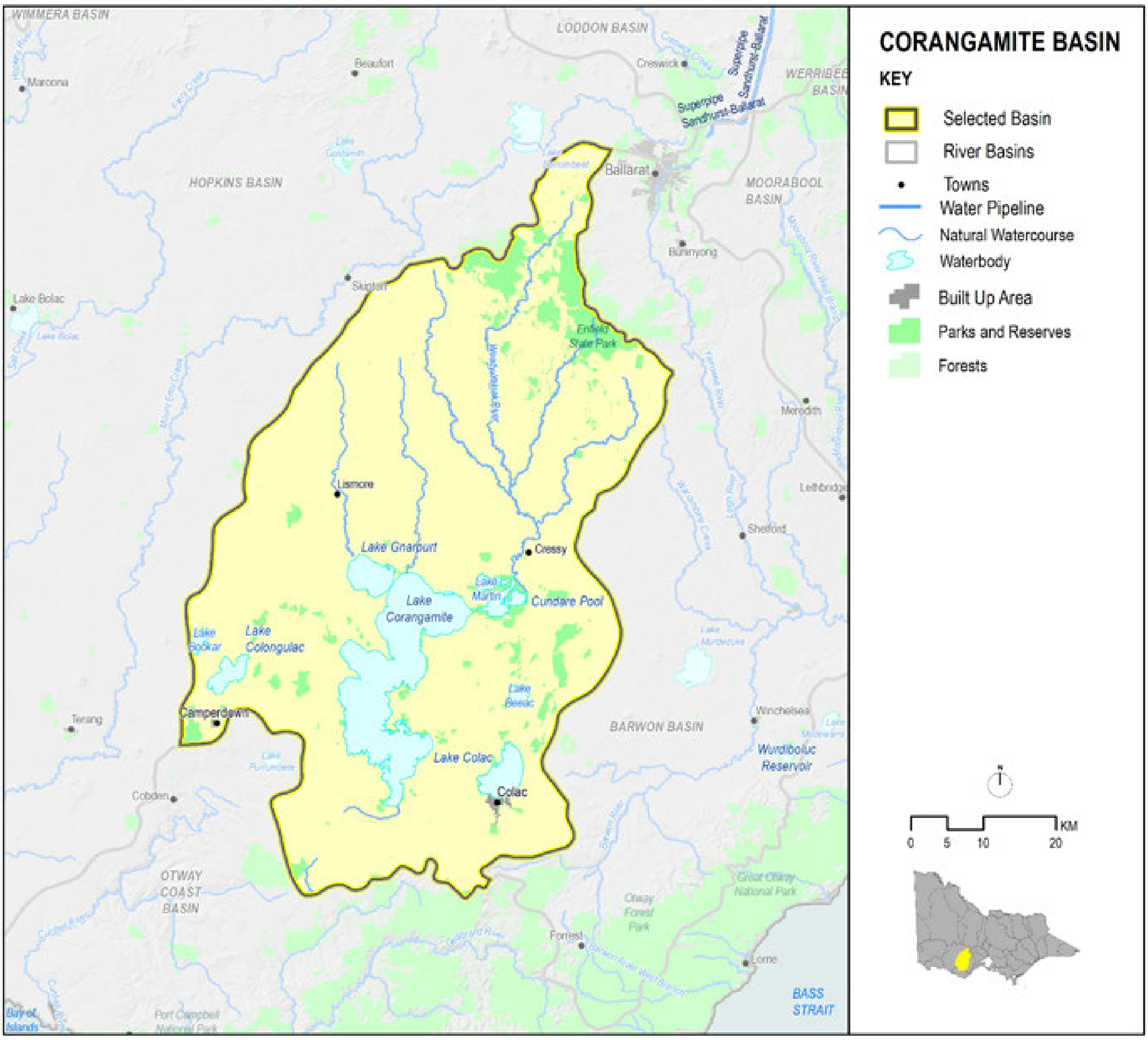
Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Upper Barwon system	-	42,466	0	**42,466**	**30,703**
Yarrowee-White Swan system	-	12,267	0	**12,267**	**7,856**
Barwon River environmental entitlement (1)	n/a	n/a	n/a	**n/a**	**n/a**
Upper Barwon river environmental entitlement	-	1,000	0	**1,000**	**0**
Take and use licences – unregulated surface water	-	5,505	0	**5,505**	**1,028**
Total 2017–18	**-**	**61,238**	**0**	**61,238**	**39,587**
Total 2016–17	-	61,243	0	61,243	44,527

Note
(1) Use under this entitlement depends on suitable river heights
n/a Not applicable.

6.22 Corangamite basin

The Corangamite basin (Figure 6-41) is located in western Victoria. Rivers and streams within the basin terminate in a series of inland lakes, the largest of which is Lake Corangamite.

Figure 6-41 Map of the Corangamite basin



6.22.1 Management arrangements

Management of water in the Corangamite basin is undertaken by various parties, the responsibilities of which Table 6-141 shows.

Table 6-141 Responsibilities for water resources management in the Corangamite basin

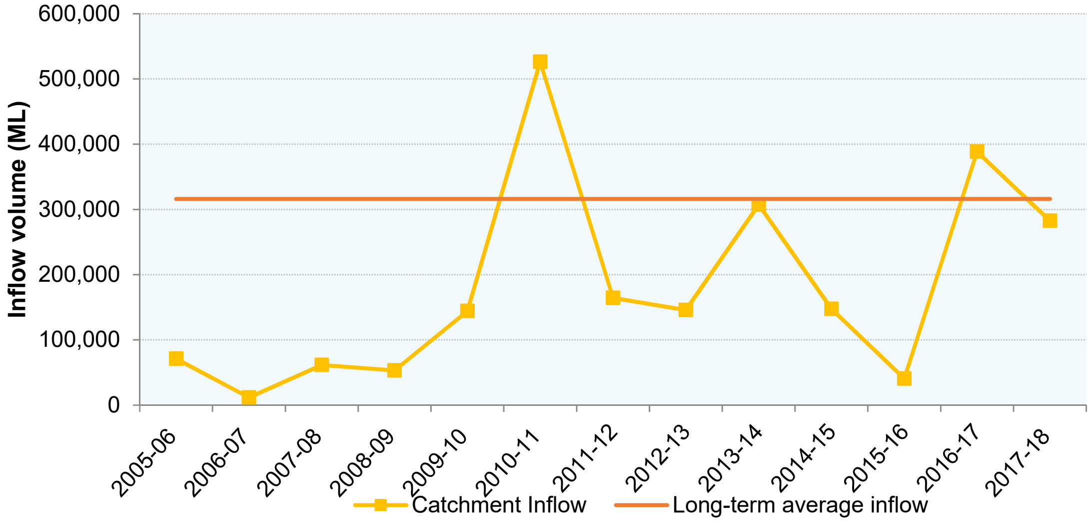
Authority	Management responsibilities
Southern Rural Water	• Manages licensed diversions
Barwon Water	• Supplies Colac and surrounding towns (from the Otway Coast basin)
Central Highlands Water	• Supplies Ballarat and surrounding towns (Ballarat system, sourced from the Moorabool, Barwon and Goulburn basins)
Wannon Water	• Provides urban water supply to Camperdown, Lismore and Derrinallum (from the Otway Coast basin)
Corangamite Catchment Management Authority	• Responsible for waterway and catchment management in the Corangamite basin

6.22.2 2017–18 Water resource overview

In 2017–18, rainfall in the Corangamite basin was mostly between 80% and 100% of the long-term average, with an area north of Lake Beeac receiving between 60% to 80% of the long-term average and an area in the south-west receiving up to 125%.

Catchment inflows across the basin were 89% of the long-term average of 316,000 ML: less than the inflows recorded in 2016–17, which were 123% of the long-term average. Unlike in most basins, the long-term average has not been revised for the Corangamite basin in 2017–18. The average will be reviewed in the 2018–19 accounts, as chapter 2.2 explains. The amount of water flowing from the Corangamite basin into the Ramsar-listed Western District Lakes represented 99% of the catchment inflows in 2017–18.

Figure 6-42 Catchment inflows in the Corangamite basin



Low rainfall and streamflow recharge for Lake Tooliorook resulted in a ban on all licensed diversions for the entirety of 2017–18.

No urban water-use restrictions were applied in the Corangamite basin in 2017–18, with all towns on permanent water-saving rules throughout the year.

In 2017–18, 2,056 ML of water was diverted for consumptive purposes (town, domestic and stock, irrigation and commercial supply). This was less than the 8,473 ML diverted in the previous year, almost all of which — 8,365 ML — was reporting of small catchment dam use: this use has reduced in this year's accounts to 2,009 ML, due to improved hydrological modelling. For more information, see Appendix E.

Water for the environment

The Western District Lakes are internationally significant wetlands listed under the Ramsar Convention and rely on the freshwater inputs from the Corangamite basin to function ecologically. These lakes include Corangamite, Gnarpurt, Milangil, Terangpom, Beeac, Colongulac and Cundare. Wetlands of national importance include the Kooraweera Lakes, Lough Calvert, Lake Thurrumbong and Cundare Pool. The native fish community and the Corangamite water skink also rely on water for the environment.

In 2017–18, water for the environment in the Corangamite basin comprised:

- the component of water in the basin not allocated for consumptive use: this water also provides social, recreational and cultural benefits
- water set aside for the environment through the operation of passing flow conditions on licensed diversions.

6.22.3 Water balance

The total volumes of water available and supplied from water resources in the Corangamite basin in 2017–18 are shown in Table 6-142.

Table 6-142 Water balance – Corangamite basin

Water account component	Note	2017–18 (ML)	2016–17 (ML)
Major on-stream storage			
Volume in storage at start of year	1	-	-
Volume in storage at end of year	1	-	-
Change in storage		**-**	**-**
Inflows			
Catchment inflow	2	282,560	388,612
Rainfall on major storages	1	-	-
Treated wastewater discharged back to river	3	1,991	1,955
Total inflows		**284,551**	**390,568**
Outflows			
Diversions			
Urban diversions		0	0
Licensed diversions from unregulated streams		47	108
Small catchment dams	4	2,009	8,365
Total diversions		***2,056***	***8,473***
Losses			
Evaporation losses from major storages	1	-	-
Evaporation from small catchment dams	4	1,393	6,391
In-stream infiltration to groundwater, flows to floodplain and evaporation	5	n/a	n/a
Total losses		***1,393***	***6,391***
Water passed at outlet of basin			
River outflows to the Corangamite Lakes		281,102	375,704
River outflows to Barwon basin via Woady Yaloak Channel		0	0
Total water passed at outlet of basin		***281,102***	***375,704***
Total outflows		**284,551**	**390,568**

Note
n/a Not applicable.

Notes to the water balance

1. Storages

There are no major water supply storages in the Corangamite basin.

2. Catchment inflow

Catchment inflow is the balancing item in this water balance. It is the difference between the total outflows and the known inflows.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-143 lists the wastewater treatment plants in the Corangamite basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-143 Volume and use of recycled water in the Corangamite basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Camperdown Industrial	45	45	100%	0	45	0	0	0	0
Camperdown Municipal	332	332	100%	12	320	0	0	0	0
Colac	1,991	0	0%	0	0	0	0	1,991	0
Total 2017–18	**2,368**	**377**	**16%**	**12**	**365**	**0**	**0**	**1,991**	**0**
Total 2016–17	2,426	471	19%	12	459	0	0	1,955	0

4. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-144 provides information about small catchment dams in the basin.

New hydrological modelling has provided a more-accurate measure of usage and harvested volumes for the 2017–18 reporting period. Therefore, the volumes for small catchment dams in 2016–17 are not directly comparable with the volumes reported for 2017–18. Each year presents the best estimate of the water harvested, used and lost, based on the best information that was available at the time. For more information, see Appendix E and chapter 6.1.2.

Table 6-144 Estimated small catchment dam information for the Corangamite basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	9,864	1,363	1,217	2,580
Registered/licensed commercial and irrigation	3,852	646	176	822
Total 2017–18	**13,715**	**2,009**	**1,393**	**3,402**
Total 2016–17	14,053	8,365	6,391	14,756

5. In-stream losses

An assessment of in-stream infiltration to groundwater, flows to floodplain and evaporation is not made in the Corangamite basin as there are no suitable models available, and this basin is primarily occupied by Lake Corangamite, making it difficult to derive losses across the basin (see chapter 6.1.2).

6.22.4 Compliance against entitlements

Compliance against water entitlements is reported in these accounts in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Corangamite – Key compliance points
✓ **There was no net increase to the total entitlement volume from the previous year.**
✓ **The total volume diverted (47 ML) was within the volume available for the year (1,177 ML).**

Entitlements in the Corangamite basin provide the basis for how water is shared in the basin. Rights to water in the Corangamite basin are outlined in Table 6-145.

Table 6-145 Entitlement volumes in the Corangamite basin

Water entitlement	Annual entitlement volume (ML)
Take and use licences – unregulated surface water	1,117
Total (30 June 2018)	**1,117**
Total (30 June 2017)	**1,117**

Table 6-146 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

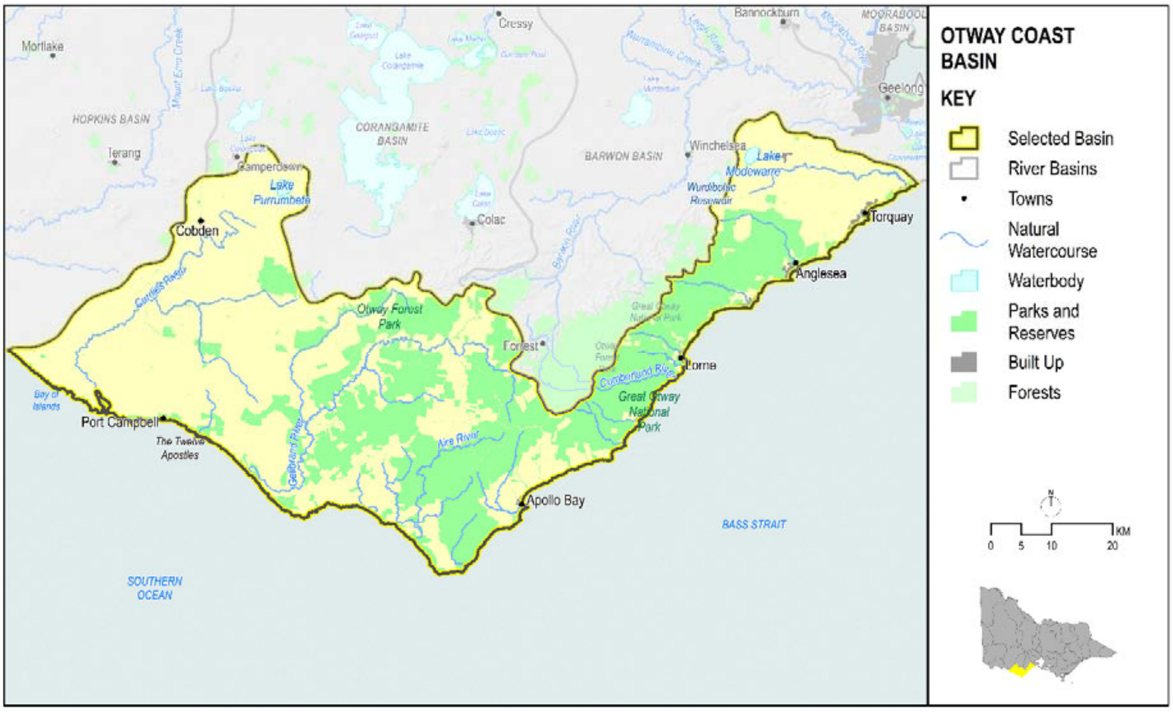
Table 6-146 Permitted and actual take for the Corangamite basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Take and use licences – unregulated surface water	-	1,117	0	**1,117**	**47**
Total 2017–18	**-**	**1,117**	**0**	**1,117**	**47**
Total 2016–17	-	1,177	0	1,177	108

6.23 Otway Coast basin

The Otway Coast basin (Figure 6-43) is located in south-west Victoria. It encompasses the numerous small creeks and rivers that flow to the coast from the Otway Ranges between Torquay and Peterborough.

Figure 6-43 Map of the Otway Coast basin



6.23.1 Management arrangements

Management of water in the Otway Coast basin is undertaken by various parties, the responsibilities of which Table 6-147 shows.

Table 6-147 Responsibilities for water resources management in the Otway Coast basin

Authority	Management responsibilities
Southern Rural Water	• Manages licensed diversions
Wannon Water	• Supplies towns including Port Campbell, Peterborough, Simpson and Cobden
Barwon Water	• Supplies the majority of towns in the basin including Lorne, Aireys Inlet, Apollo Bay and towns in the northern part of the basin from Geelong's water supply (which comes from the Barwon basin) • Transfers water out of the basin to supply Colac and surrounding towns • Operates West Gellibrand Reservoir and other reservoirs used to supply towns
Corangamite Catchment Management Authority	• Responsible for waterway and catchment management in the Otway Coast basin

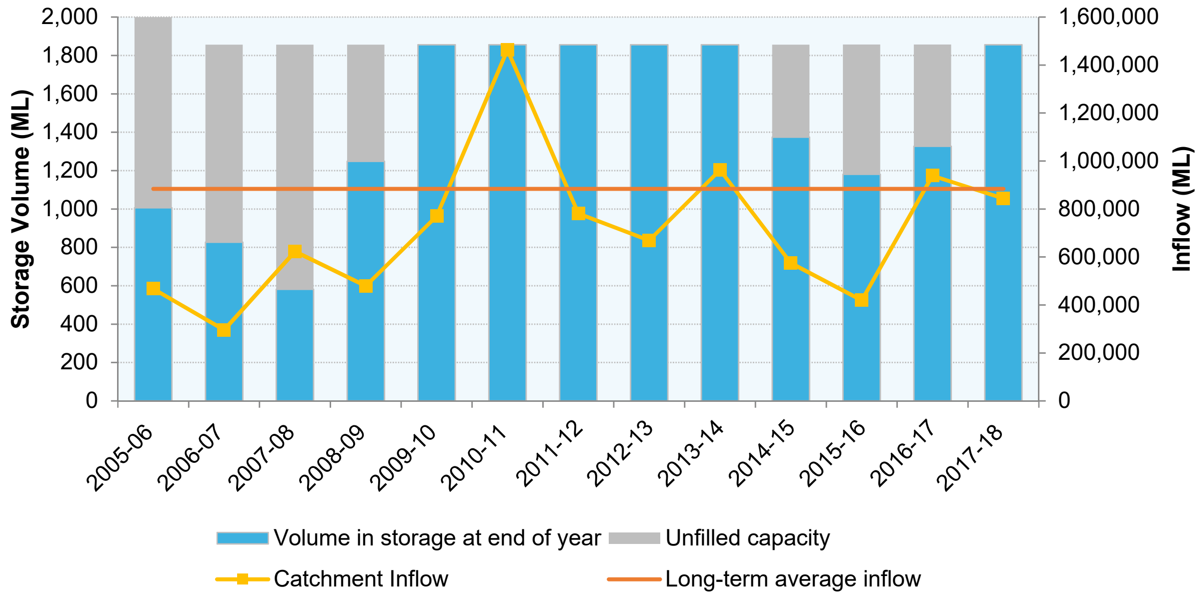
6.23.2 2017–18 Water resource overview

In 2017–18, rainfall in the west of the Otway Coast basin was between 100% and 125% of the long-term average, while the remainder of the basin received between 60% and 80% of the average.

Catchment inflows were 95% of the long-term average of 884,000 ML: less than the inflows recorded in 2016–17, which were 106% of the long-term average. Unlike most basins, the long-term average has not been revised for the Otway Coast basin in 2017–18. The average will be reviewed in the 2018–19 accounts, as chapter 2.2 explains. The amount of water flowing into Bass Strait represented 97% of the catchment inflows in the basin in 2017–18.

Storage levels in West Gellibrand Reservoir started 2017–18 at 71% and ended the year at 100% of total capacity.

Figure 6-44 Storage volumes and catchment inflows in the Otway Coast basin



In 2017–18, licensed diversions from the Curdies and Carlisle rivers were banned from early February to early May 2018.

There were no urban water-use restrictions applied in the Otway Coast basin in 2017–18, with all towns on permanent water-saving rules throughout the year.

In 2017–18, 23,511 ML of water was diverted for consumptive purposes (town, domestic and stock, irrigation and commercial supply). This was less than the 28,907 ML diverted in the previous year. Some of the change from the previous year's diversion is related to the reporting of small catchment dam use, which reduced from 15,556 ML last year to only 9,535 ML this year, due to improved hydrological modelling. For more information, see Appendix E.

Water for the environment

Several important environmental assets in the Otway basin depend on water for the environment, including:

- Aire River (a heritage river) and more specifically the Lower Aire wetlands, which are of national significance
- the Aire River estuary, which is of state significance
- the upper Aire River, which is a representative river
- Elliot River, Parker River, Grey River, Carisbrook Creek and Smythes Creek, which are ecologically healthy waterways
- native fish communities (such as river blackfish and Australian grayling) and their habitats (such as remnant riparian vegetation)
- lakes Costin and Craven
- endangered, flow-dependent ecological vegetation classes including estuarine wetland and swamp scrub
- the native bird population including the great egret (a Victorian rare or threatened species), Cape Barren goose and Australasian bittern
- native mammals including platypus and swamp antechinus
- macroinvertebrate communities in areas such as Elliot River, St Georges River and Wye River

In 2017–18, water for the environment in the Otway Coast basin comprised:

- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements held by Barwon Water and Wannon Water
- water set aside for the environment through the operation of passing flow conditions on licensed diversions
- all other water in the basin not allocated for consumptive use: this water also provides social, recreational and cultural benefits.

6.23.3 Water balance

The total volumes of water available and supplied from water resources in the Otway Coast basin in 2017–18 are shown in Table 6-148.

Table 6-148 Water balance – Otway Coast basin

Water account component	Note	2017–18 (ML)	2016–17 (ML)
Major on-stream storage			
Volume in storage at start of year	1	1,327	1,181
Volume in storage at end of year	1	1,856	1,327
Change in storage		**529**	**146**
Inflows			
Catchment inflow	2	844,092	938,488
Rainfall on major storages	1	339	363
Treated wastewater discharged back to river	3	96	209
Total inflows		**844,527**	**939,061**
Outflows			
Diversions			
Urban diversions		13,262	12,584
Licensed diversions from unregulated streams		715	766
Small catchment dams	4	9,535	15,556
Total diversions		***23,511***	***28,907***
Losses			
Evaporation losses from major storages	1	295	43
Evaporation from small catchment dams	4	3,353	4,591
In-stream infiltration to groundwater, flows to floodplain and evaporation	5	n/a	n/a
Total losses		***3,648***	***4,634***
Water passed at outlet of basin			
River outflows to the ocean		816,839	905,374
Total water passed at outlet of basin		***816,839***	***905,374***
Total outflows		**843,998**	**938,915**

Note
n/a Not applicable.

Notes to the water balance

1. Storages

Major on-stream storages in the Otway Coast basin are included in the water balance. A breakdown of the volumes presented are in Table 6-149.

Table 6-149 Storage volumes in the Otway Coast basin

Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
West Gellibrand Reservoir	1,856	1,327	339	295	485	1,856
Total storage volumes 2017–18	**1,856**	**1,327**	**339**	**295**	**485**	**1,856**
Total storage volumes 2016–17	1,856	1,181	363	43	(174)	1,327

2. Catchment inflow

Catchment inflow is the balancing item in this water balance. It is the difference between the total outflows, the known inflows and the net change in storage volume.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin.

Table 6-150 lists the wastewater treatment plants in the Otway Coast basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-150 Volume and use of recycled water in the Otway basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Aireys Inlet	0	0	0%	0	0	0	0	0	0
Anglesea	312	48	15%	0	48	0	0	0	263
Apollo Bay	468	2	0%	0	2	0	0	0	467
Cobden	168	108	64%	0	108	0	0	61	0
Lorne	285	0	0%	0	0	0	0	0	285
Peterborough	22	22	100%	0	22	0	0	0	0
Port Campbell	71	56	79%	0	56	0	0	15	0
Simpson	21	0	0%	0	0	0	0	21	0
Timboon	61	61	100%	0	61	0	0	0	0
Total 2017–18	**1,408**	**297**	**21%**	**0**	**297**	**0**	**0**	**97**	**1,015**
Total 2016–17	1,587	256	13%	0	209	0	47	210	1,123

4. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-151 provides information about small catchment dams in the basin.

New hydrological modelling has provided a more-accurate measure of usage and harvested volumes for the 2017–18 reporting period. Therefore, the volumes for small catchment dams in 2016–17 are not directly comparable with the volumes reported for 2017–18. Each year presents the best estimate of the water harvested, used and lost, based on the best information that was available at the time. For more information, see Appendix E and chapter 6.1.2.

Table 6-151 Estimated small catchment dam information for the Otway Coast basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	13,686	4,943	2,515	7,458
Registered/licensed commercial and irrigation	10,004	4,592	838	5,430
Total 2017–18	**23,691**	**9,535**	**3,353**	**12,887**
Total 2016–17	24,274	15,556	4,591	20,147

5. In-stream losses

An assessment of in-stream infiltration to groundwater, flows to floodplain and evaporation is not made in the Otway Coast basin as there are no suitable models available to make an estimate of the total losses (see chapter 6.1.2).

6.23.4 Compliance against entitlements

Compliance against water entitlements is reported in these accounts in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Otway Coast – Key compliance points

- ✓ **There was a net increase in the total entitlement volume of 393 ML from the previous year: this increase was allowed and entitlement was issued under auction by Southern Rural Water.**
- ✓ **The total volume diverted (13,977 ML) was within the volume available for the year (26,110 ML).**
- ✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
- ✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the Otway Coast basin provide the basis for how water is shared in the basin. Rights to water in the Otway Coast basin are outlined in Table 6-152

Table 6-152 Entitlement volumes in the Otway Coast basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Aireys Inlet) Conversion Order 1997	317
Bulk Entitlement (Apollo Bay) Order 2010	800
Bulk Entitlement (Colac) Amendment Order 2003	5,400
Bulk Entitlement (Gellibrand) Conversion Order 1997	60
Bulk Entitlement (Lorne) Conversion Order 1997	510
Bulk Entitlement (Otway Coast) Conversion Order 1998	12,580
Take and use licences – unregulated surface water	6,436
Total (30 June 2018)	**26,103**
Total (30 June 2017)	**25,710**

Table 6-153 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

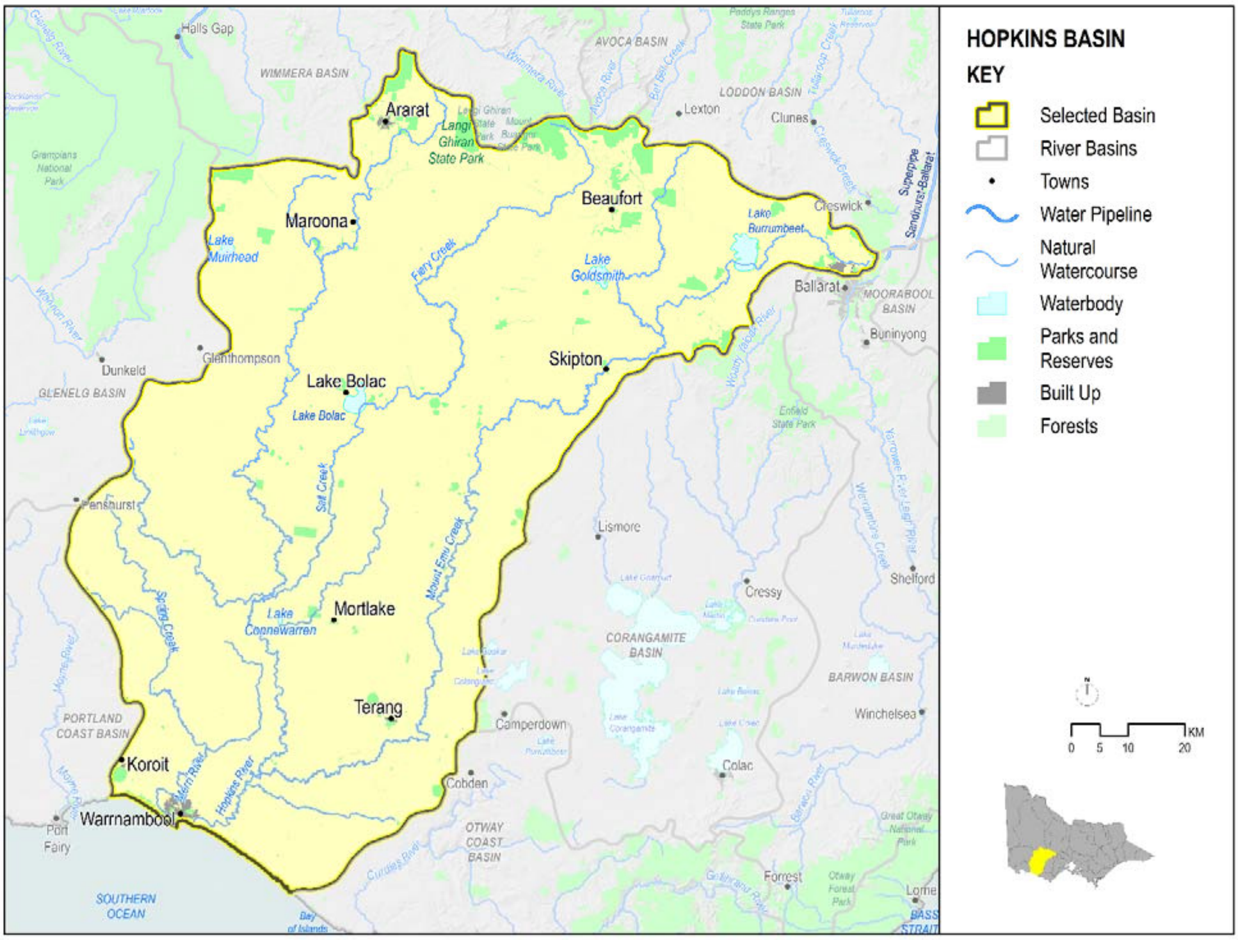
Table 6-153 Available water and take for the Otway Coast basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Aireys Inlet	-	317	0	**317**	**0**
Apollo Bay	-	800	0	**800**	**394**
Colac	-	5,400	0	**5,400**	**3,615**
Gellibrand	-	60	0	**60**	**21**
Lorne	-	510	0	**510**	**463**
Otway system	-	12,580	0	**12,580**	**8,769**
Take and use licences – unregulated surface water	-	6,443	0	**6,443**	**715**
Total 2017–18	**-**	**26,110**	**0**	**26,110**	**13,977**
Total 2016–17	-	26,497	0	26,497	13,350

6.24 Hopkins basin

The Hopkins basin (Figure 6-45) is located in south-western Victoria. The two major rivers within the basin are the Merri River and Hopkins River.

Figure 6-45 Map of the Hopkins basin



6.24.1 Management arrangements

Management of water in the Hopkins basin is undertaken by various parties, these responsibilities are outlined in Table 6-154.

Table 6-154 Responsibilities for water resources management in the Hopkins basin

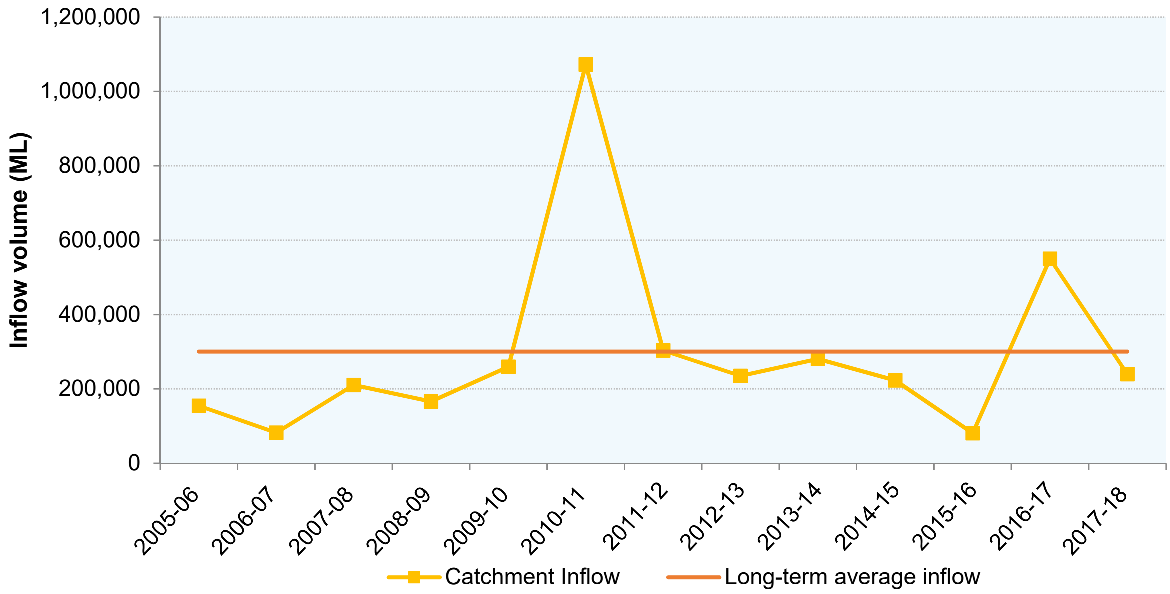
Authority	Management responsibilities
Southern Rural Water	• Manages groundwater and surface water licensed diversions (except Loddon Highlands WSPA, which is managed by Goulburn-Murray Water)
Wannon Water	• Supplies towns and cities in the south of the basin including Warrnambool
Grampians Wimmera Mallee Water	• Supplies towns and cities in the north of the basin including Ararat
Central Highlands Water	• Supplies towns in the north-east of the basin including Beaufort and Skipton
Glenelg Hopkins Catchment Management Authority	• Responsible for waterway and catchment management in the whole of the Hopkins basin

6.24.2 2017–18 Water resource overview

Rainfall throughout most of the Hopkins basin in 2017–18 was between 80% and 100% of the long-term average with a small area in the south-east corner receiving between 100% and 125%.

The long-term average used in the 2017–18 accounts has been revised from previous accounts and is now an average of post-1975 streamflow, as chapter 2.2 explains. Catchment inflows in 2017–18 were 80% of the revised long-term average annual volume of 300,588 ML: less than the inflows recorded in 2016–17, which were 183% of the revised long-term average. The volume of water flowing from the Hopkins basin into Bass Strait represented 96% of the catchment inflows, compared to 93% in 2016–17.

Figure 6-46 Catchment inflows in the Hopkins basin



Brucknell Creek, the Hopkins and Merri rivers and Mount Emu Creek all began the year on a stage 1 roster in July 2017. The roster remained in place for Brucknell Creek for most of 2017–18, except September 2017 when the stream was unrestricted. All other streams were unrestricted in August and September 2017 until stage 1 rosters were enforced from October to December 2017. Mount Emu Creek was the only stream raised to a stage 4 roster in January 2018; eventually a total ban on all diversions was put in place from February until April 2018. January also saw stage 2 restrictions implemented for the Hopkins and Merri rivers. Merri River was kept on stage 2 restrictions until April 2018, before reverting to stage 1 for the remainder of the year. The Hopkins River progressed to stage 3 restrictions during February and March 2018, before reverting to stage 2 in April 2018. All streams had stage 1 rosters in place from May 2018 until June 2018.

There were no urban restrictions applied in the Hopkins basin in 2017–18, with all towns on permanent water-saving rules throughout the year.

In 2017–18, 6,351 ML of water was diverted for consumptive purposes (town, domestic and stock, irrigation and commercial supply). This was less than the 23,628 ML diverted in the previous year. The vast majority (21,446 ML) of last years' diversion was reporting small catchment dam use, which has reduced this year to 3,738 ML, due to improved hydrological modelling. For more information, see Appendix E.

Water for the environment

Important environmental assets (such as the coastal salt marsh wetlands and the wetlands associated with the Merri River estuary) depend on water in the Hopkins basin. Other important environmental assets in the basin include:

- the Hopkins River, a major waterway draining the eastern part of the region and entering the Southern Ocean at Warrnambool
- Hopkins estuary, the Merri River and Fiery Creek
- Brucknell Creek and Deep Creek, which provide important fish habitat for species including the Australian grayling and river blackfish
- Mt Emu Creek, which contains reaches with relatively intact remnant riparian vegetation and deep, permanent pools providing drought refuge for threatened species.

In 2017–18, water for the environment in the Hopkins basin comprised:

- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements held by Central Highlands Water
- water set aside for the environment through the operation of licensed diversions in passing flow conditions, particularly for Cudgee and Mt Emu creeks
- all other water in the basin not allocated for consumptive use: this water also provides social, recreational and cultural benefits.

6.24.3 Water balance

The total volumes of water available and supplied from water resources in the Hopkins basin in 2017–18 are shown in Table 6-155.

Table 6-155 Water balance – Hopkins basin

Water account component	Note	2017–18 (ML)	2016–17 (ML)
Major on-stream storage			
Volume in storage at start of year	1	-	-
Volume in storage at end of year	1	-	-
Change in storage		**-**	**-**
Inflows			
Catchment inflow	2	239,832	550,034
Rainfall on major storages	1	-	-
Treated wastewater discharged back to river	3	0	478
Total inflows		**239,832**	**550,512**
Outflows			
Diversions			
Urban diversions		175	164
Licensed diversions from unregulated streams		2,439	2,018
Small catchment dams	4	3,738	21,446
Total diversions		***6,351***	***23,628***
Losses			
Evaporation losses from major storages	1	-	-
Evaporation from small catchment dams	4	3,051	17,749
In-stream infiltration to groundwater, flows to floodplain and evaporation	5	n/a	n/a
Total losses		***3,051***	***17,749***
Water passed at outlet of basin			
River outflows to the ocean		230,430	509,134
Total water passed at outlet of basin		***230,430***	***509,134***
Total outflows		**239,832**	**550,512**

Note
n/a Not applicable.

Notes to the water balance

1. Storages

There are no major storages — storages greater than 1,000 ML — in the Hopkins basin.

2. Catchment inflow

Catchment inflow is the balancing item in this water balance. It is the difference between the total outflows and the known inflows.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-156 lists the wastewater treatment plants in the Hopkins basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-156 Volume and use of recycled water in the Hopkins basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Ararat	613	551	89%	122	422	0	7	0	62
Beaufort	63	63	100%	0	63	0	0	0	0
Cardigan Village	20	20	100%	0	20	0	0	0	0
Mortlake	56	56	100%	8	48	0	0	0	0
Skipton	0	0	0%	0	0	0	0	0	0
Terang	211	211	100%	0	211	0	0	0	0
Warrnambool	5,474	135	1%	53	0	0	82	0	5,339
Willaura	30	8	27%	8	0	0	0	0	22
Total 2017–18	**6,467**	**1,044**	**16%**	**191**	**764**	**0**	**89**	**0**	**5,423**
Total 2016–17	6,940	793	10%	144	567	0	82	479	5,669

4. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-157 provides information about small catchment dams in the basin.

New hydrological modelling has provided a more-accurate measure of usage and harvested volumes for the 2017–18 reporting period. Therefore, the volumes for small catchment dams in 2016–17 are not directly comparable with the volumes reported for 2017–18. Each year presents the best estimate of the water harvested, used and lost, based on the best information that was available at the time. For more information, see Appendix E and chapter 6.1.2.

Table 6-157 Estimated small catchment dam information for the Hopkins basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	27,942	2,914	2,750	5,664
Registered/licensed commercial and irrigation	8,146	823	301	1,124
Total 2017–18	**36,088**	**3,738**	**3,051**	**6,788**
Total 2016–17	36,977	21,446	17,750	39,196

5. In-stream losses

An assessment of in-stream infiltration to groundwater, flows to floodplain and evaporation is not made in the Hopkins basin as there are no suitable models available, and the distribution of streamflow gauges across the basin makes it difficult to estimate in-stream losses (see chapter 6.1.2).

6.24.4 Compliance against entitlements

Compliance against water entitlements is reported in these accounts in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Hopkins – Key compliance points

- ✓ **There was no net increase to the total entitlement volume from the previous year.**
- ✓ **The total volume diverted (2,614 ML) was within the volume available for the year (12,036 ML).**
- ✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
- ✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the Hopkins basin provide the basis for how water is shared in the basin. Rights to water in the Hopkins basin are outlined in Table 6-158.

Grampians Wimmera Mallee Water's bulk entitlement to the Hopkins basin (Willarua, Elmhurst and Buangor) is reported in the Wimmera basin, as it covers water sourced from both basins, most of which is sourced from the Wimmera.

Table 6-158 Entitlement volumes in the Hopkins basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Beaufort) Conversion Order 2005	419
Bulk Entitlement (Skipton) Conversion Order 2005	210
Take and use licences – unregulated surface water	11,395
Total (30 June 2018)	**12,024**
Total (30 June 2017)	**12,036**

Table 6-159 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

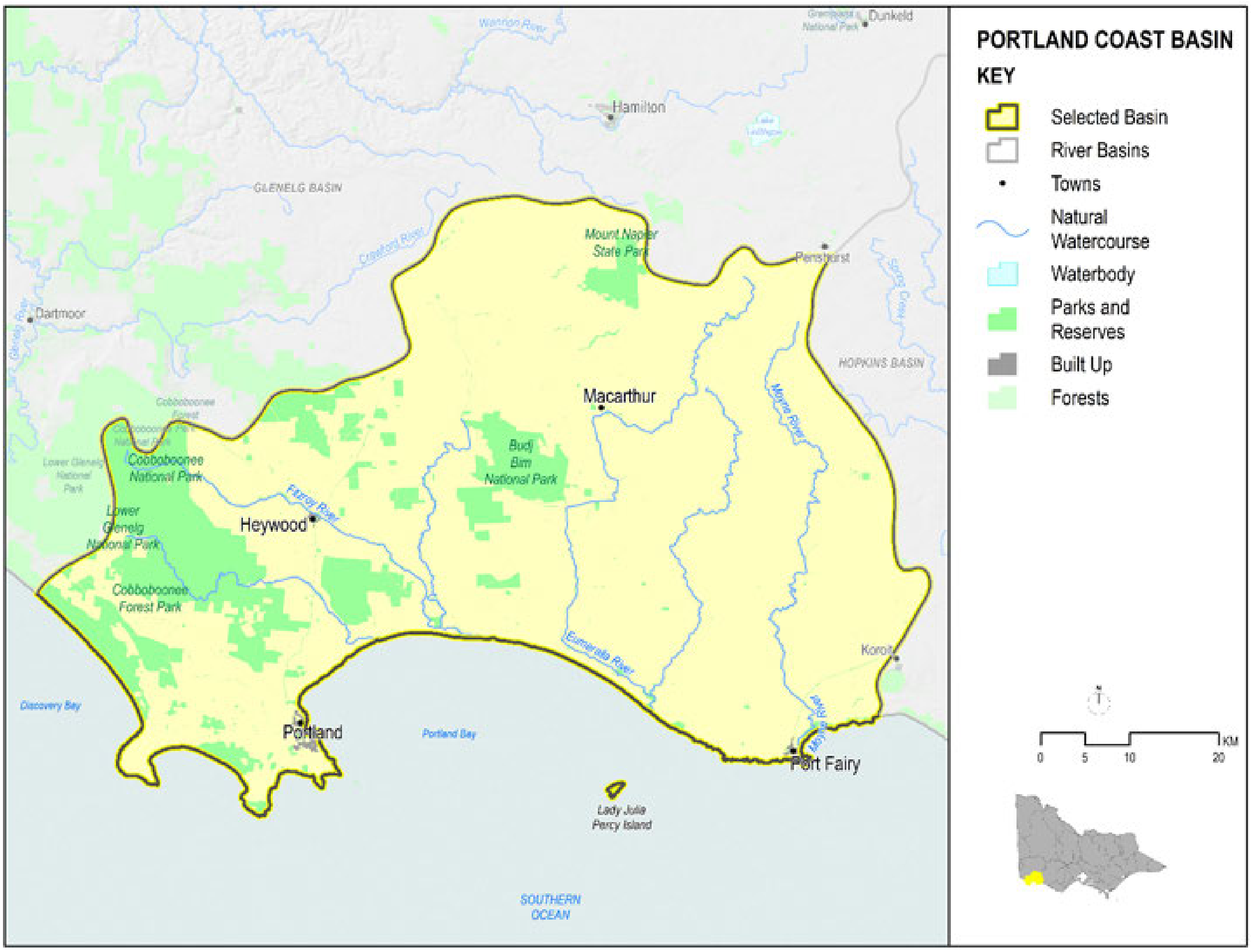
Table 6-159 Available water and take for the Hopkins basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Beaufort	-	419	0	**419**	**175**
Skipton	-	210	0	**210**	**0**
Take and use licences – unregulated surface water	-	11,407	0	**11,407**	**2,439**
Total 2017–18	**-**	**12,036**	**0**	**12,036**	**2,614**
Total 2016–17	-	12,265	0	12,265	2,182

6.25 Portland Coast basin

The Portland Coast basin (Figure 6-47) is in south-western Victoria. Major rivers in the basin include the Moyne, Eumeralla, Fitzroy and Surrey rivers.

Figure 6-47 Map of the Portland Coast basin



6.25.1 Management arrangements

Management of water in the Portland Coast basin is undertaken by various parties, the responsibilities of which Table 6-160 shows.

Table 6-160 Responsibilities for water resources management in the Portland Coast basin

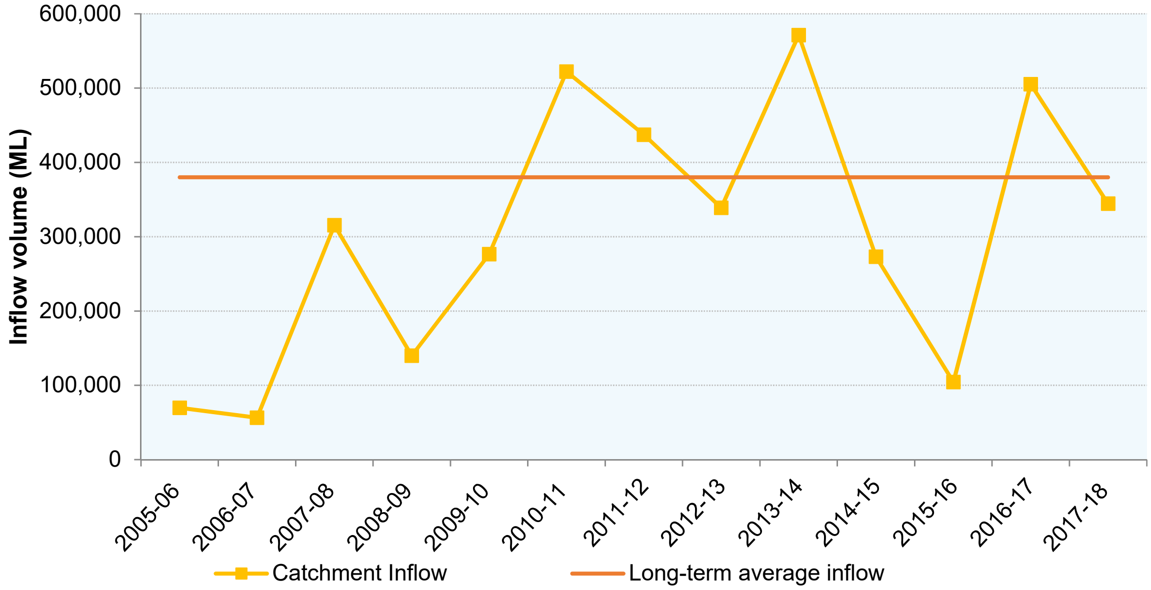
Authority	Management responsibilities
Southern Rural Water	• Manages licensed diversions
Wannon Water	• Supplies groundwater to Koroit, Port Fairy, Heywood and Portland
Glenelg Hopkins Catchment Management Authority	• Responsible for waterway and catchment management in the whole Portland Coast basin

6.25.2 2017–18 Water resource overview

Rainfall throughout most of the Portland Coast basin in 2017–18 was between 100% and 125% of the long-term average, except for the south-east, which received between 80% and 100%.

The long-term average used in the 2017–18 accounts has been revised from previous accounts and is now an average of post-1975 streamflow, as chapter 2.2 explains. Catchment inflows were 91% of the revised long-term average annual volume of 379,972 ML: lower than the inflows recorded in 2016–17, which were 133% of the revised long-term average.

Figure 6-48 Catchment inflows in the Portland Coast basin



A ban on licensed diversions was implemented for the Fitzroy River in December 2018, followed by the Eumeralla, Moyne and Surrey rivers in January 2018. Restrictions continued until April 2018 for the Eumeralla and Moyne rivers, and until May 2018 for the Fitzroy and Surrey rivers.

No urban water-use restrictions applied in the Portland Coast basin in 2017–18, with all towns remaining on permanent water-saving rules throughout the year.

In 2017–18, 1,931 ML of water was diverted for consumptive purposes (town, domestic and stock, irrigation and commercial supply). This was less than the 3,847 ML diverted in the previous year. The only diversion in the Portland Coast basin is the reporting of small catchment dam use, and the large reduction in this volume from last year is due to improved hydrological modelling. For more information, see Appendix E.

Water for the environment

Important environmental assets that rely on water for the environment in this basin include:

- Lake Condah and the Budj Bim National Heritage Landscape, which is a volcanic plain that encompasses the area from Budj Bim to the sea and which supports manna gum woodlands and many rare and threatened aquatic fauna including the Yarra pygmy perch
- the Fitzroy River – Darlots Creek system, where Darlots Creek flows south from Condah to the Fitzroy River at Tyrendarra and into the Southern Ocean via the Fitzroy River estuary. The area contains a number of threatened species.

Other important rivers in this basin include the Moyne and Surrey rivers and the Eumeralla/Shaw river system.

In 2017–18, water for the environment in the Portland Coast basin comprised:

- water in the basin not otherwise allocated for consumptive use: this water also provides social, recreational and cultural benefits
- water set aside for the environment through the operation of passing flow conditions on licensed diversions, particularly for Condah Drain, Darlot Creek and the Fitzroy, Moyne and Surrey rivers.

6.25.3 Water balance

The total volumes of water available and supplied from water resources in the Portland Coast basin in 2017–18 are shown in Table 6-161.

Table 6-161 Water balance – Portland Coast basin

Water account component	Note	2017–18 (ML)	2016–17 (ML)
Major on-stream storage			
Volume in storage at start of year	1	-	-
Volume in storage at end of year	1	-	-
Change in storage			**-**
Inflows			
Catchment inflow	2	344,469	505,275
Rainfall on major storages	1	-	-
Treated wastewater discharged back to river	3	316	277
Total inflows		**344,785**	**505,552**
Outflows			
Diversions			
Licensed diversions from unregulated streams		0	0
Small catchment dams	4	1,931	3,847
Total diversions		***1,931***	***3,847***
Losses			
Evaporation losses from major storages	1	-	-
Evaporation from small catchment dams	4	1,181	3,273
In-stream infiltration to groundwater, flows to floodplain and evaporation	5	n/a	n/a
Total losses		***1,181***	***3,273***
Water passed at outlet of basin			
River outflows to the ocean		341,673	498,432
Total water passed at outlet of basin		***341,673***	***498,432***
Total outflows		**344,785**	**505,552**

Note
n/a Not applicable.

Notes to the water balance

1. Storages

There are no major storages — storages greater than 1,000 ML — in the Portland Coast basin.

2. Catchment inflow

Catchment inflow is the balancing item in this water balance. It is the difference between the total outflows and the known inflows.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-162 lists the wastewater treatment plants in the Portland Coast basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-162 Volume and use of recycled water in the Portland basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Heywood	399	83	21%	0	83	0	0	316	0
Port Fairy Domestic	765	0	0%	0	0	0	0	0	765
Port Fairy Industrial	151	0	0%	0	0	0	0	0	151
Portland	1,361	0	0%	0	0	0	0	0	1,361
Total 2017–18	**2,676**	**83**	**3%**	**0**	**83**	**0**	**0**	**316**	**2,277**
Total 2016–17	2,884	63	2%	0	63	0	0	277	2,544

4. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-163 provides information about small catchment dams in the basin.

New hydrological modelling has provided a more-accurate measure of usage and harvested volumes for the 2017–18 reporting period. Therefore, the volumes for small catchment dams in 2016–17 are not directly comparable with the volumes reported for 2017–18. Each year presents the best estimate of the water harvested, used and lost, based on the best information that was available at the time. For more information, see Appendix E and chapter 6.1.2.

Table 6-163 Estimated small catchment dam information for the Portland Coast basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	6,594	1,792	1,141	2,934
Registered/licensed commercial and irrigation	497	139	40	179
Total 2017–18	**7,090**	**1,931**	**1,181**	**3,113**
Total 2016–17	7,265	3,847	3,273	7,120

5. In-stream losses

An assessment of in-stream infiltration to groundwater, flows to floodplain and evaporation is not made in the Portland Coast basin as there are no suitable models available, and the distribution of streamflow gauges across the basin makes it difficult to estimate in-stream losses (see chapter 6.1.2).

6.25.4 Compliance against entitlements

Compliance against water entitlements is reported in these accounts in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Portland – Key compliance points
✓ **There was no net increase to the total entitlement volume from the previous year.**
✓ **The total volume diverted (0 ML) was within the volume available for the year (1,078 ML).**
✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the Portland Coast basin provide the basis for how water is shared in the basin. Rights to water in the Portland Coast basin are outlined in Table 6-164.

Table 6-164 Entitlement volumes in the Portland Coast basin

Water entitlement	Annual entitlement volume (ML)
Take and use licences – unregulated surface water	1,078
Total (30 June 2018)	**1,078**
Total (30 June 2017)	**1,078**

Table 6-165 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

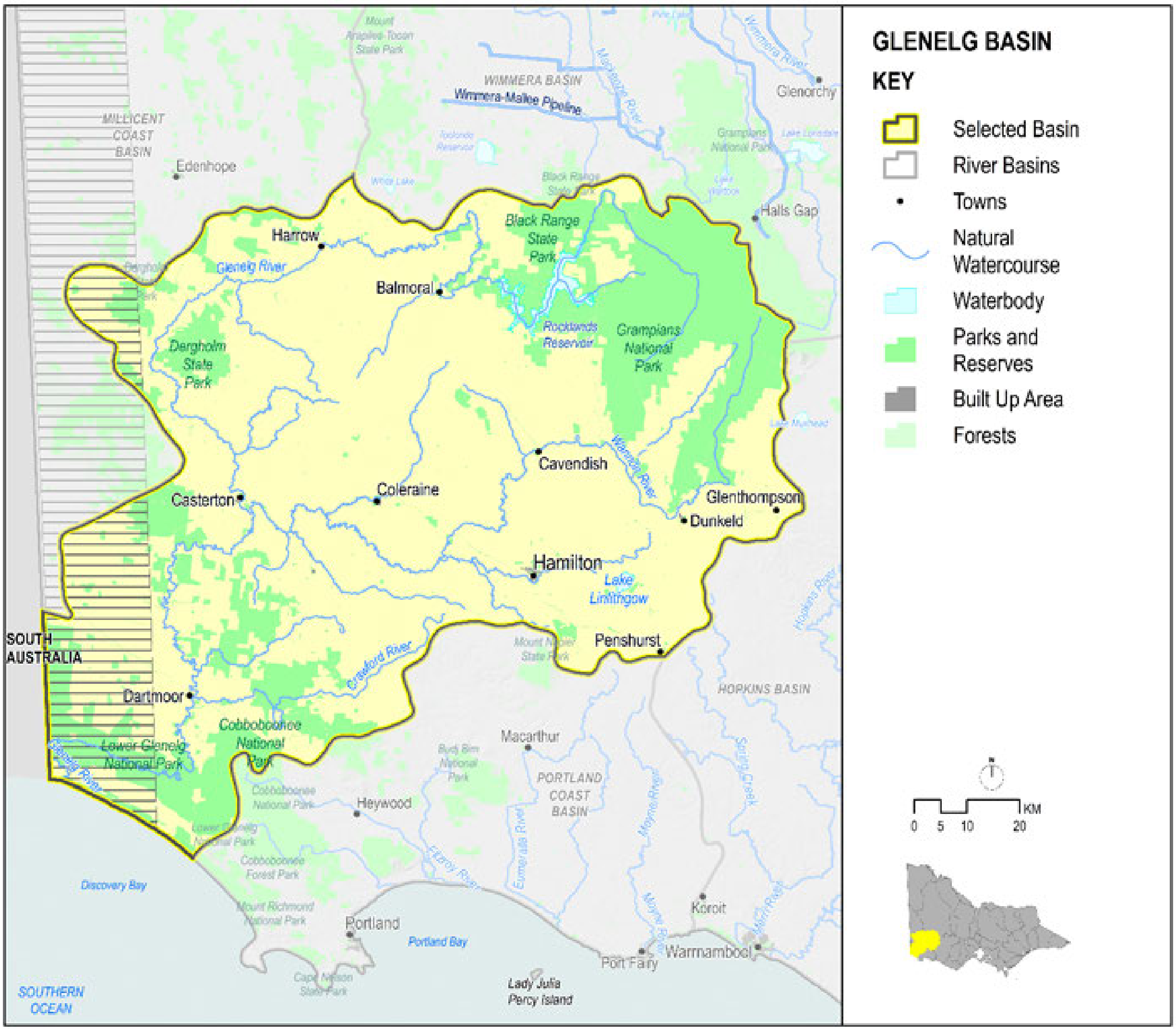
Table 6-165 Available water and take for the Portland Coast basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Take and use licences – unregulated surface water	-	1,078	0	1,078	0
Total 2017–18	**-**	**1,078**	**0**	**1,078**	**0**
Total 2016–17	-	1,078	0	1,078	0

6.26 Glenelg basin

The Glenelg basin (Figure 6-49) is in the far west of Victoria. It has four on-stream storages, the largest of which is Rocklands Reservoir.

Figure 6-49 Map of the Glenelg basin



6.26.1 Management arrangements

Management of water in the Glenelg basin is undertaken by various parties, the responsibilities of which Table 6-166 shows.

Table 6-166 Responsibilities for water resources management in the Glenelg basin

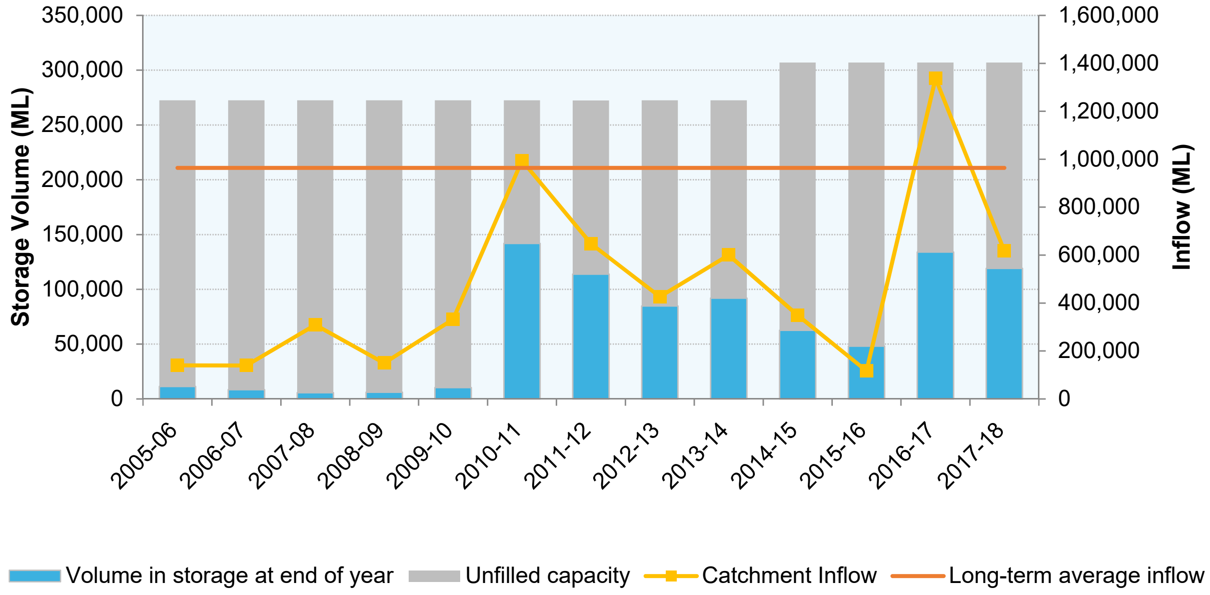
Authority	Management responsibilities
Southern Rural Water	• Manages licensed diversions for the entire basin except the Glenelg River north of the bridge on the Casterton–Harrow Road
Grampians Wimmera Mallee Water	• Manages licensed diversions for the Glenelg River north of the bridge on the Casterton–Harrow Road • Supplies Harrow • Operates the Wimmera–Glenelg system which includes Rocklands and Moora Moora reservoirs and several other small-diversion weirs in the upper Glenelg and Wannon rivers
Wannon Water	• Supplies all other towns in the basin • Operates reservoirs in the Hamilton supply system
Glenelg Hopkins Catchment Management Authority	• Responsible for waterway and catchment management in the Glenelg basin

6.26.2 2017–18 Water resource overview

Most of the Glenelg basin received between 100% and 125% of the long-term average rainfall in 2017–18, with an area north of Cavendish, Hamilton and Balmoral receiving between 80% and 100% of the long-term average.

Catchment inflows in the Glenelg basin in 2017–18 were 64% of the long-term average (964,000 ML): less than the inflows recorded in 2016–17, which were 139% of the long-term average. Unlike most basins, the long-term average has not been revised for the Glenelg basin in 2017–18. The average will be reviewed in the 2018–19 accounts, as chapter 2.2 explains. The basin's largest water storage, Rocklands Reservoir, started the year at 43% of capacity and was at 39% by the end of June 2018.

Figure 6-50 Storage volumes and catchment inflows in the Glenelg basin



The Crawford River was the only unregulated stream within the Glenelg basin to be placed on restrictions during 2017–18. A ban on all licensed diversions was implemented in December 2017 and remained in place until May 2018.

There were no urban restrictions applied in the Glenelg basin in 2017–18, with all towns in the basin on permanent water-saving rules throughout the year.

In 2017–18, 21,903 ML of water was diverted for consumptive purposes (town, domestic and stock, irrigation and commercial supply). This was less than the 33,593 ML diverted in the previous year. Some of the change from the previous year's diversion is related to the reporting of small catchment dam use, which reduced from 18,899 ML last year to only 7,107 ML this year, due to improved hydrological modelling. For more information, see Appendix E.

Water for the environment

The lower Glenelg River is a heritage river and depends on water for the environment in the Glenelg basin to function ecologically. Other important environmental assets that also rely on water for the environment in this basin are:

- Glenelg spiny crayfish (listed as threatened under the Victorian *Flora and Fauna Guarantee Act 1988* and only found in the Glenelg basin)
- Yarra and Ewens pygmy perch (listed as vulnerable under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* and threatened under the *Flora and Fauna Guarantee Act 1988*)
- variegated pygmy perch (listed as vulnerable under the *Environmental Protection and Biodiversity Conservation Act 1999* and threatened under the *Flora and Fauna Guarantee Act* 1988)
- a new subspecies of the Wimmera bottlebrush (*Melaleuca wimmerensis,* formerly known as *Callistemon wimmerensis*) discovered on the Glenelg River. This species appears to have similar characteristics to the Wimmera subspecies, which is very dependent on flows. This species is listed as threatened under the *Flora and Fauna Guarantee Act 1988* and has been nominated for listing under the *Environmental Protection and Biodiversity Conservation Act 1999*.

In 2017–18, water for the environment in the Glenelg basin comprised:

- a share of water available under the *Wimmera and Glenelg Rivers Environmental Entitlement 2010* which includes 40,560 ML of high-reliability entitlement; water available under this entitlement is shared with the Wimmera basin
- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements held by Grampians Wimmera Mallee Water and Wannon Water
- water set aside for the environment through the operation of passing flows conditions as part of the environmental entitlement held by the VEWH
- water set aside for the environment through the operation of passing flow conditions on licensed diversions, particularly Crawford River, Glenelg River, Grange Burn and Wannon River
- all other water in the basin not allocated for consumptive use: this water also provides social, recreational and cultural benefits.

In 2017–18, a total of 11,000 ML of environmental water was used in the Glenelg basin. This was all delivered in-stream for the Glenelg River.

6.26.3 Water balance

The total volumes of water available and supplied from water resources in the Glenelg basin in 2017–18 are shown in Table 6-167.

Table 6-167 Water balance – Glenelg basin

Water account component	Note	2017–18 (ML)	2016–17 (ML)
Major on-stream storage			
Volume in storage at start of year	1	132,036	48,165
Volume in storage at end of year	1	119,162	134,014
Change in storage		**(12,874)**	**85,849**
Inflows			
Catchment inflow	2	617,198	1,336,753
Rainfall on major storages	1	17,997	25,797
Treated wastewater discharged back to river	3	299	604
Total inflows		**635,494**	**1,363,154**
Outflows			
Diversions			
Urban diversions		1,876	1,776
Transfers to the Wimmera basin		12,828	12,870
Licensed diversions from unregulated streams		92	50
Small catchment dams	4	7,107	18,899
Total diversions		***21,903***	***33,595***
Losses			
Evaporation losses from major storages	1	22,909	26,752
Evaporation from small catchment dams	4	5,887	19,024
In-stream infiltration to groundwater, flows to floodplain and evaporation		71,506	161,180
Total losses		***100,303***	***206,957***
Water passed at outlet of basin			
River outflows to the ocean		526,162	1,036,754
Total water passed at outlet of basin		***526,162***	***1,036,754***
Total outflows		**648,368**	**1,277,306**

Notes to the water balance

1. Storages

Major on-stream storages in the Glenelg basin are included in the water balance. A breakdown of the volumes presented are in Table 6-168. In previous years, Hamilton system reservoirs were included as on-stream storages. This was an error: they are off-stream and have been removed from the water balance in 2017–18.

The difference between the 2016–17 closing balance reported in the water balance and the 2017–18 opening balance is the volume in store in the Hamilton system reservoirs at the end of the previous water year.

Table 6-168 Storage volumes in the Glenelg basin

Storage	Total capacity (ML) (1)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Konongwootong Reservoir	1,920	1,826	431	678	240	1,819
Moora Moora Reservoir	6,300	3,810	2,349	3,070	491	3,580
Rocklands Reservoir	296,000	126,400	15,216	19,161	(8,692)	113,763
Total storage volumes 2017–18	**304,220**	**132,036**	**17,997**	**22,909**	**(7,961)**	**119,162**
Total storage volumes 2016–17	306,829	48,165	25,797	26,752	86,803	134,014

Note

(1) Volumes shown are the maximum operating capacities of storages.

2. Catchment inflow

Catchment inflow is the balancing item in this water balance. It is the difference between the total outflows, the known inflows and the net change in storage volume.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-169 lists the wastewater treatment plants in the Glenelg basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Wannon Water operates all treatment plants within the Glenelg basin. Overall, 69% of wastewater was recycled in 2017–18, more than the volume recycled in 2016–17.

Table 6-169 Volume and use of recycled water in the Glenelg basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Casterton	135	75	55%	0	75	0	0	60	0
Coleraine	25	23	93%	0	23	0	0	2	0
Dunkeld	11	11	100%	11	0	0	0	0	0
Hamilton	810	572	71%	65	507	0	0	237	0
Total 2017–18	**981**	**681**	**69%**	**76**	**605**	**0**	**0**	**299**	**0**
Total 2016–17	1,237	631	51%	76	556	0	0	604	0

4. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-170 provides information about small catchment dams in the basin.

New hydrological modelling has provided a more-accurate measure of usage and harvested volumes for the 2017–18 reporting period. Therefore, the volumes for small catchment dams in 2016–17 are not directly comparable with the volumes reported for 2017–18. Each year presents the best estimate of the water harvested, used and lost, based on the best information that was available at the time. For more information, see Appendix E and chapter 6.1.2.

Table 6-170 Estimated small catchment dam information for the Glenelg basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	32,525	6,519	5,668	12,187
Registered/licensed commercial and irrigation	3,084	588	219	807
Total 2017–18	**35,610**	**7,107**	**5,887**	**12,994**
Total 2016–17	36,465	18,899	19,025	37,924

6.26.4 Compliance against entitlements

Compliance against water entitlements is reported in these accounts in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Glenelg – Key compliance points
✓ **There was no net increase to the total entitlement volume from the previous year.**
✓ **The total volume diverted (1,968 ML) was within the volume available for the year (5,598 ML).**
✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the Glenelg basin provide the basis for how water is shared in the basin. Rights to water in the Glenelg basin are outlined in Table 6-171.

The Wimmera–Glenelg system is unique because the headworks harvest water from both the Glenelg and Wimmera river systems, and the volumes supplied to entitlement holders cannot be disaggregated between the two basins. Therefore, the entitlement volumes and diversions are presented in the Wimmera basin chapter in Table 6-183.

Under Grampians Wimmera Mallee Water's Wimmera and Glenelg rivers bulk entitlement, the water corporation operates the Wimmera–Glenelg system headworks to supply water to towns and customers connected to the

Wimmera Mallee Pipeline. It includes 3,300 ML for the Glenelg Compensation Flow. It also supplies entitlements held by Coliban Water, Wannon Water and the VEWH.

The *Wimmera and Glenelg Rivers Environmental Entitlement 2010* provides the VEWH with water from the Wimmera–Glenelg system headworks to provide environmental benefits in both the Wimmera and Glenelg basins. In the Glenelg basin, water available under the environmental entitlement is used to support streamflows and is not diverted out of waterways to water environmental assets.

Table 6-171 Entitlement volumes in the Glenelg basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Coleraine, Casterton, Sandford) Conversion Order 1997	855
Bulk Entitlement (Dunkeld System) Conversion Order 1997	170
Bulk Entitlement (Glenthompson) Conversion Order 1997	94
Bulk Entitlement (Hamilton) Conversion Order 1997	3,435
Take and use licences – unregulated surface water	1,044
Total (30 June 2018)	**5,598**
Total (30 June 2017)	**5,598**

Table 6-172 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

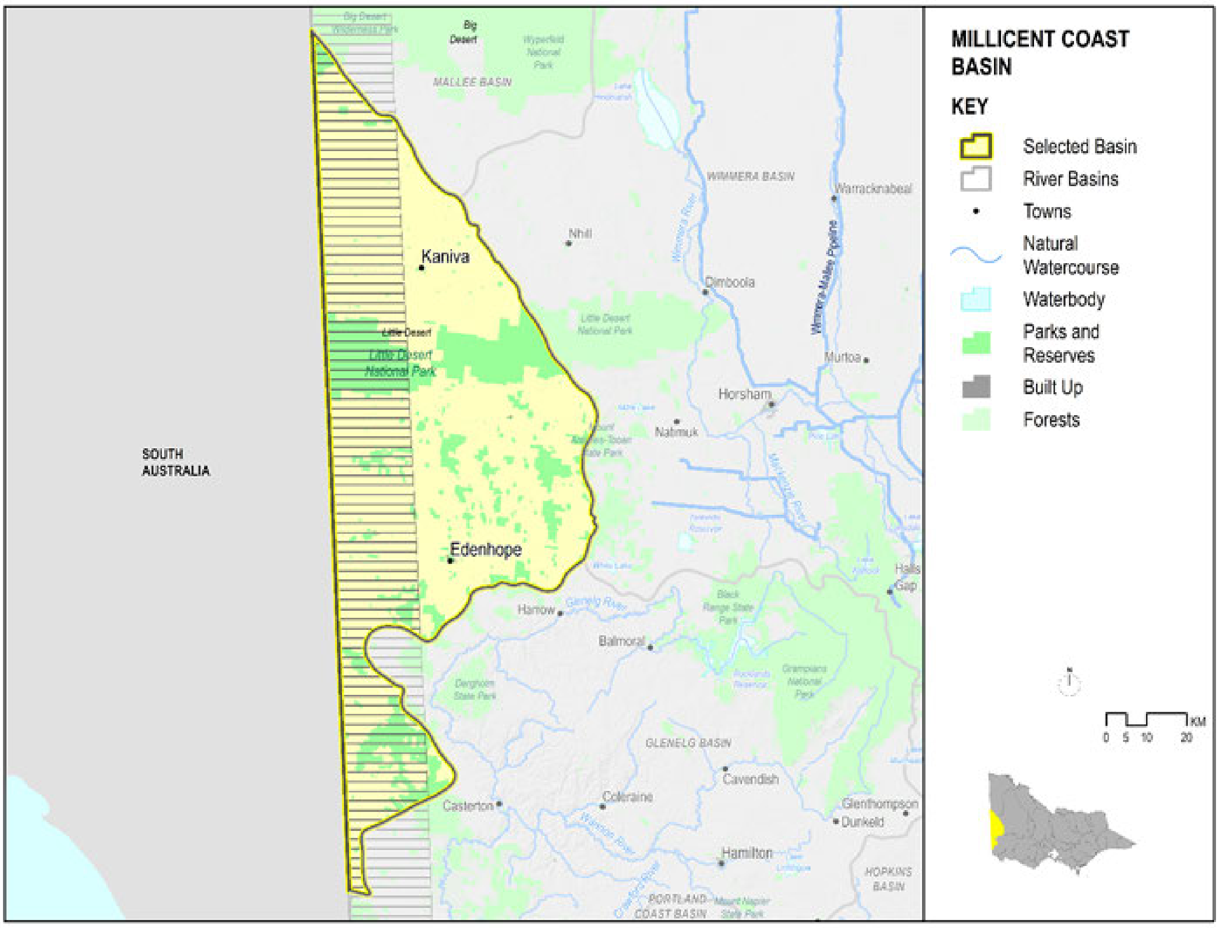
Table 6-172 Available water and take for the Glenelg basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Coleraine, Casterton, Sandford	-	855	0	**855**	**384**
Dunkeld system	-	170	0	**170**	**2**
Glenthompson	-	94	0	**94**	**0**
Hamilton	-	3,435	0	**3,435**	**1,490**
Take and use licences – unregulated surface water	-	1,044	0	**1,044**	**92**
Total 2017–18	**-**	**5,598**	**0**	**5,598**	**1,968**
Total 2016–17	-	5,600	0	5,600	1,826

6.27 Millicent Coast basin

The Millicent Coast basin (Figure 6-51) spans parts of both Victoria and South Australia. The Victorian section of the basin comprises numerous internally draining interdune wetlands located mainly in the south and several minor waterways which flow intermittently and continue into South Australia. Groundwater is the most significant resource in the basin.

Figure 6-51 Map of the Millicent Coast basin



6.27.1 Management arrangements

Management of water in the Millicent Coast basin is undertaken by various parties, the responsibilities of which Table 6-173 shows.

Table 6-173 Responsibilities for water resources management in the Millicent Coast basin

Authority	Management responsibilities
Grampians Wimmera Mallee Water	• Manages licensed diversions in the Millicent Coast basin • Supplies all towns including Kaniva and Edenhope
Wimmera Catchment Management Authority	• Responsible for waterway and catchment management in the majority of the Millicent Coast basin
Glenelg Hopkins Catchment Management Authority	• Responsible for waterway and catchment management in the southern part of the Millicent Coast basin

6.27.2 2017–18 Water resource overview

In 2017–18, rainfall throughout the southern part of the Millicent Coast basin was between 100% and 125% of the long-term average, with the northern part receiving between 80% to 100%.

Groundwater is the main source of water supply in the Millicent Coast basin, and this is covered by the West Wimmera GMA. Chapter 7.6.1 has information about groundwater licences and use in this area.

Licensed diversions from unregulated streams were unrestricted throughout the year.

No urban water-use restrictions applied in the Millicent Coast basin in 2017–18, with all towns on permanent water-saving rules throughout the year.

Water for the environment

The Millicent Coast basin contains numerous wetlands. The largest waterway in the basin, the ephemeral Mosquito Creek, provides streamflows to support Ramsar-listed wetlands in South Australia including Bool and Hacks lagoons.

In 2017–18, water for the environment in the Millicent Coast basin comprised all water in the basin not allocated for consumptive use: this water also provides social, recreational and cultural benefits.

6.27.3 Water balance

Limited information is available for surface water availability and use, so a water balance has not been included for the Millicent Coast basin.

Notes to the resource condition

1. Storages

There are no storages in the Millicent Coast basin.

2. Catchment inflow

No reliable streamflow data exists for the Millicent Coast basin. As such, an estimate of the volume of water leaving the basin was not made. As catchment inflow is back-calculated from outflows, an assessment of the available water in the basin (catchment inflow) has not been made. Any surface water not diverted flows to South Australia.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-174 lists the wastewater treatment plants in the Millicent Coast basin.

Table 6-174 Volume and use of recycled water in the Millicent Coast basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Edenhope	56	40	71%	40	0	0	0	0	16
Kaniva North	3	0	0%	0	0	0	0	0	3
Kaniva South	9	0	0%	0	0	0	0	0	9
Serviceton	8	0	0%	0	0	0	0	0	8
Total 2017–18	**76**	**40**	**53%**	**40**	**0**	**0**	**0**	**0**	**36**
Total 2016–17	106	38	36%	38	0	0	0	0	68

4. Small catchment dams

The volume of water harvested, used and lost by small catchment dams (farm dams) is presented in Table 6-175.

New hydrological modelling has provided a more-accurate measure of usage and harvested volumes for the 2017–18 reporting period. Therefore, the volumes for small catchment dams in 2016–17 are not directly comparable with the volumes reported for 2017–18. Each year presents the best estimate of the water harvested, used and lost, based on the best information that was available at the time. For more information, see Appendix E and chapter 6.1.2.

Table 6-175 Estimated small catchment dam information for the Millicent Coast basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	4,656	230	791	1,020
Registered/licensed commercial and irrigation	5,071	459	202	661
Total 2017–18	**9,727**	**689**	**993**	**1,681**
Total 2016–17	7,401	5,609	2,458	8,067

5. In-stream losses

There is no suitable model available to make an estimate of in-stream losses, as there are no streamflow gauges in the Millicent Coast basin (see chapter 6.1.2).

6.27.4 Compliance against entitlements

Compliance against water entitlements is reported in these accounts in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Millicent Coast – Key compliance points
✓ **There was no net increase to the total entitlement volume from the previous year.**
✓ **The total volume diverted (4 ML) was within the volume available for the year (4 ML).**

Entitlements in the Millicent basin provide the basis for how water is shared in the basin. Rights to water in the Millicent Coast basin are outlined in Table 6-176.

Table 6-176 Entitlement volumes in the Millicent Coast basin

Water entitlement	Annual entitlement volume (ML)
Take and use licences – unregulated surface water	4
Total (30 June 2018)	**4**
Total (30 June 2017)	**4**

Table 6-177 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

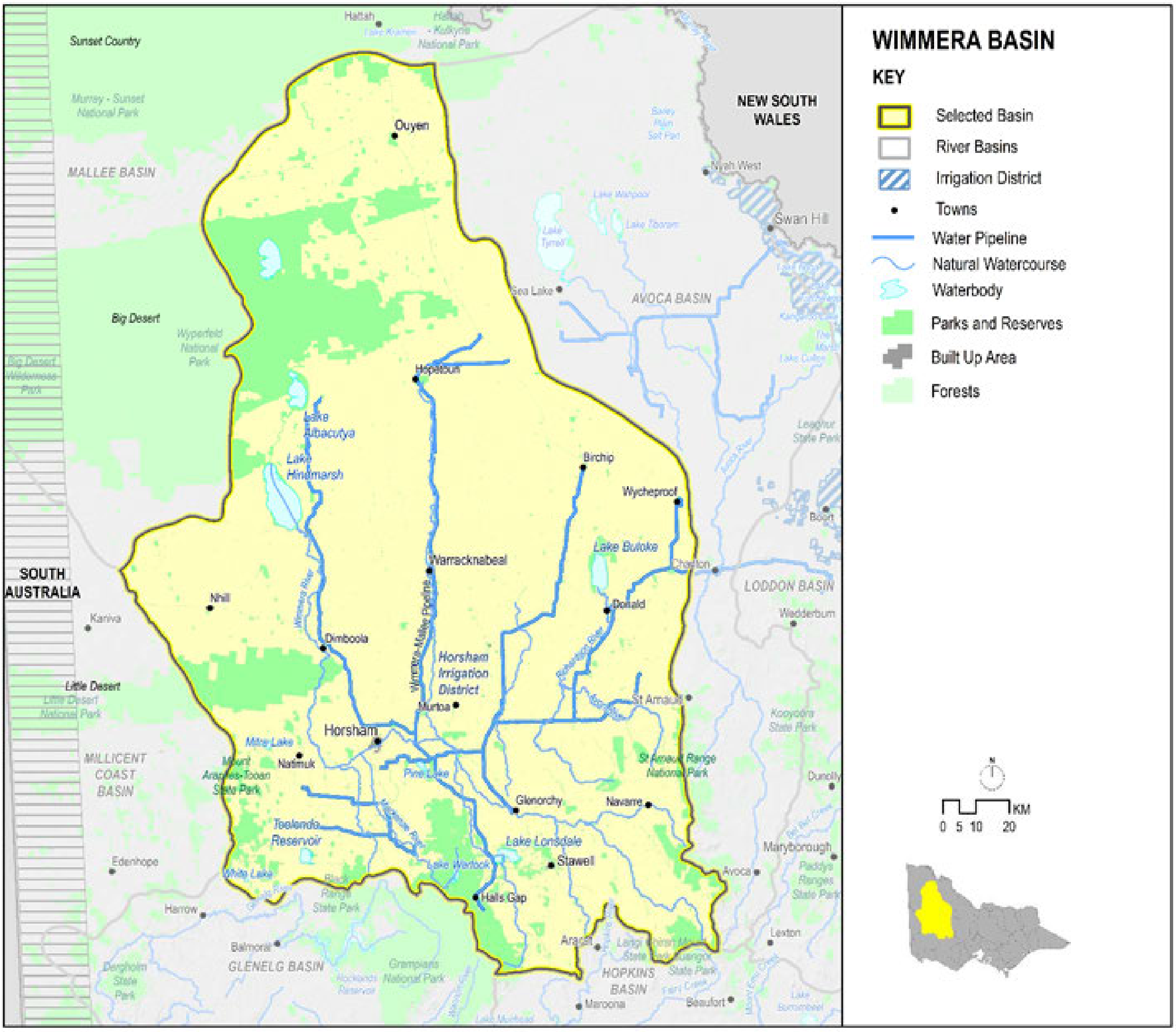
Table 6-177 Available water and take for the Millicent Coast basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Take and use licences – unregulated surface water	-	4	0	**4**	**4**
Total 2017–18	**-**	**4**	**0**	**4**	**4**
Total 2016–17	-	4	0	4	4

6.28 Wimmera basin

The Wimmera basin (Figure 6-52) is the largest landlocked river basin in Victoria. The Wimmera River's headwaters are near Mt Cole in the Pyrenees Ranges. The river flows westwards across the foothills of the Grampians, and at Horsham it turns north and flows for about 150 km, terminating at Lake Hindmarsh.

Figure 6-52 Map of the Wimmera basin



6.28.1 Management arrangements

Management of water in the Wimmera basin is undertaken by various parties, the responsibilities of which Table 6-178 shows.

Table 6-178 Responsibilities for water resources management in the Wimmera basin

Authority	Management responsibilities
Grampians Wimmera Mallee Water	• Manages the Wimmera Mallee supply system which delivers water to farms in the Wimmera basin (1) • Manages licensed diversions • Supplies most towns in the Wimmera basin (1) • Provides bulk supply to some of Coliban Water's towns in the Loddon basin • Operates the Wimmera–Glenelg water headworks system
Central Highlands Water	• Supplies Landsborough and Navarre
Coliban Water	• Supplies Borung, Korong Vale, Wedderburn and Wychitella
Goulburn-Murray Water	• Provides Grampians Wimmera Mallee Water with bulk supplies for domestic and stock use from the Goulburn system via the Waranga Main Channel
Wimmera Catchment Management Authority	• Responsible for waterway and catchment management in the Wimmera River catchment
North Central Catchment Management Authority	• Responsible for waterway and catchment management in the east of the basin, including the Avon and Richardson rivers

Note
(1) Grampians Wimmera Mallee Water also supplies farms and towns in the Avoca and Mallee basins.

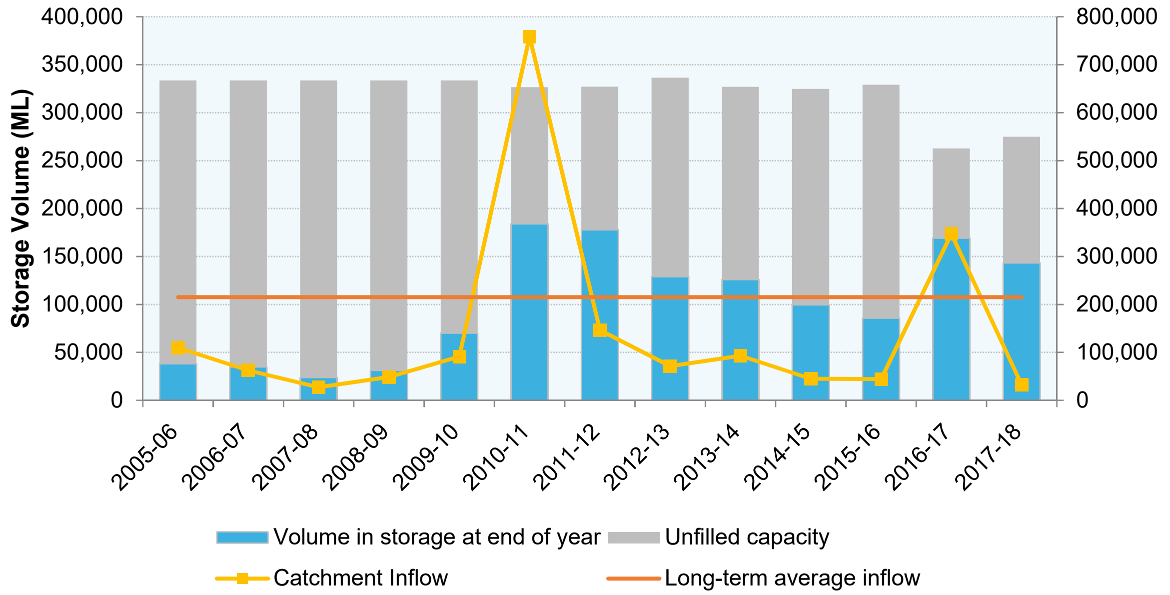
6.28.2 2017–18 Water resource overview

In 2017–18, rainfall across the south of the basin, on the western basin boundary and around the Wyperfeld National Park was between 80% and 100% of the long-term average. A large area in the east and north-east of the basin bordering Stawell, Horsham and Murtoa, and along the northern edge of the basin above Ouyen, received between 60% to 80% of the long-term average.

The long-term average used in the 2017–18 accounts has been revised from previous accounts and is now an average of post-1975 streamflow, as chapter 2.2 explains. Catchment inflows in the Wimmera basin in 2017–18 were 15% of the revised long-term average (215,188 ML): less than the inflows recorded in 2016–17, which were 162% of the revised long-term average.

Storage levels in the Wimmera basin started the year at 50% and ended the year at 52% of total capacity.

Figure 6-53 Storage volumes and catchment inflows in the Wimmera basin



The opening seasonal determination for the Wimmera Mallee Pipeline was announced on 7 July 2017 at 37%, and it increased to 81% by October 2017.

The Wimmera River was subject to a ban on all licensed diversions for the entirety of 2017–18.

There were no urban restrictions applied within the Wimmera basin in 2017–18, with all towns in the basin on permanent water-saving rules throughout the year.

In 2017–18, 19,310 ML of water was diverted for consumptive purposes (town, domestic and stock, irrigation and commercial supply). This was less than the 32,634 ML diverted in the previous year. Some of the change from the previous year's diversion is related to the reporting of small catchment dam use, which reduced from 18,310 ML last year to only 2,136 ML this year, due to improved hydrological modelling. For more information, see Appendix E.

Water for the environment

The Wimmera River is a heritage river that depends on water for the environment. Important environmental assets in the Wimmera basin include platypus, freshwater catfish and river blackfish. Other important environmental assets include:

- the regionally threatened populations of native fish (river blackfish, southern pygmy perch and mountain galaxias) and platypus (of which there are believed to be less than 10, with this the only population in the catchment) in the MacKenzie River
- the only known population of the Wimmera bottlebrush (*Melaleuca wimmerensis,* formerly known as *Callistemon wimmerensis*) which has recently been classified under the Victorian *Flora and Fauna Guarantee Act 1988* (the FFG Act); this species depends on flows in the MacKenzie River for its survival and recruitment
- the lower Wimmera River, which is listed under the *Heritage Rivers Act 1992* and which flows into Lake Hindmarsh (listed as a nationally significant wetland) and Lake Albacutya (a Ramsar-listed wetland). It contains Victoria's only self-sustaining population of freshwater catfish (which is an FFG-Act-listed species). The Wimmera River also contains stocked populations of Murray cod and silver perch which are both FFG-Act-listed species.

In 2017–18, water for the environment in the Wimmera basin comprised:

- the *Wimmera and Glenelg Rivers Environmental Entitlement 2010* held by the VEWH, comprising 40,560 ML of high-reliability entitlement shared with the Glenelg basin and 1,000 ML of entitlement for wetlands supplied from the Wimmera Mallee Pipeline

- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements held by Grampians Wimmera Mallee Water and conditions on licensed diversions
- a supply by agreement with the CEWH under Grampians Wimmera Mallee Water's bulk entitlement comprising 28,000 ML of low-reliability entitlement
- all other water in the basin not allocated for consumptive use: this water also provides social, recreational and cultural benefits.

A total of 27,625 ML of environmental water was used in the Wimmera basin in 2017–18; 279 ML of this was diverted off-stream while the remaining water was delivered in-stream.

6.28.3 Water balance

The total volumes of water available and supplied from water resources in the Wimmera basin in 2017–18 are shown in Table 6-179.

Table 6-179 Water balance – Wimmera basin

Water account component	Note	2017–18 (ML)	2016–17 (ML)
Major on-stream storage			
Volume in storage at start of year	1	169,205	85,800
Volume in storage at end of year	1	143,242	169,205
Change in storage		**(25,963)**	**83,405**
Inflows			
Catchment inflow	2	32,478	347,538
Rainfall on major storages	1	33,070	32,114
Transfer from Glenelg basin		12,828	12,870
Treated wastewater discharged back to river	3	0	335
Total inflows		**78,376**	**392,856**
Outflows			
Diversions			
Urban diversions and domestic and stock use		14,382	12,763
Diversions for irrigation		0	0
Licensed diversions from unregulated streams		422	166
Environmental water diversions to wetlands		279	119
Supply to designated recreational lakes		2,091	1,275
Small catchment dams	4	2,136	18,310
Total diversions		***19,310***	***32,634***
Losses			
Evaporation losses from major storages	1	37,066	46,678
Evaporation from small catchment dams	4	2,757	14,099
In-stream infiltration to groundwater, flows to floodplain and evaporation	5	19,162	24,288
Total losses		***58,986***	***85,064***
Water passed at outlet of basin			
River outflows to Lake Buloke		49	36,066
River outflows to Lake Hindmarsh (measured at Tarranyurk)		25,995	155,687
Total water passed at outlet of basin		***26,044***	***191,753***
Total outflows		**104,339**	**309,451**

Notes to the water balance

1. Storages

Major on-stream storages in the Wimmera basin are included in the water balance. A breakdown of the volumes presented are in Table 6-180.

Table 6-180 Storage volumes in the Wimmera basin

Storage	Total capacity (ML) (1)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Fyans Lake	18,460	13,838	1,677	4,219	1,396	12,691
Green Lake	5,350	3,402	0	0	(560)	2,842
Lake Bellfield	78,560	63,805	3,405	3,389	(1,973)	61,848
Lake Lonsdale	65,480	32,850	17,677	8,348	(24,523)	17,656
Taylors Lake	27,060	20,570	1,563	5,162	516	17,487
Toolondo Reservoir	50,533	13,495	2,974	9,332	8,789	15,926
Wartook Reservoir	29,300	21,245	5,775	6,616	(5,612)	14,792
Total storage volumes 2017–18	**274,743**	**169,205**	**33,070**	**37,066**	**(21,967)**	**143,242**
Total storage volumes 2016–17	262,563	85,800	32,114	46,678	97,969	169,205

2. Catchment inflow

Catchment inflow is the balancing item in this water balance. It is the difference between the total outflows, the known inflows and the net change in storage volume.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-181 lists the wastewater treatment plants in the Wimmera basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-181 Volume and use of recycled water in the Wimmera basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Birchip	44	21	49%	0	21	0	0	0	22
Dimboola	99	10	10%	0	10	0	0	0	89
Donald	110	74	68%	0	74	0	0	0	36
Halls Gap	128	85	66%	34	51	0	0	0	43
Hopetoun	20	0	0%	0	0	0	0	0	20
Horsham	1,041	570	55%	120	450	0	0	0	471
Jeparit	23	0	0%	0	0	0	0	0	23
Minyip	20	0	0%	0	0	0	0	0	20
Murtoa	51	50	98%	0	50	0	0	0	1
Natimuk	13	0	0%	0	0	0	0	0	13
Nhill	116	52	45%	0	52	0	0	0	64
Ouyen	59	0	0%	0	0	0	0	0	59
Rainbow	33	0	0%	0	0	0	0	0	33
Rupanyup	16	1	6%	0	1	0	0	0	15
Stawell (1)	466	478	103%	199	279	0	0	0	(12)
Warracknabeal	170	86	50%	86	0	0	0	0	84
Wycheproof	28	28	100%	0	28	0	0	0	0
Total 2017–18	**2,437**	**1,455**	**60%**	**439**	**1,016**	**0**	**0**	**0**	**981**
Total 2016–17	2,638	1,685	64%	385	1,302	0	0	335	619

Note
(1) The difference between volume produced and volume supplied for Stawell is balanced through drawdown of reclaimed storage.

4. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-182 provides information about small catchment dams in the basin.

New hydrological modelling has provided a more-accurate measure of usage and harvested volumes for the 2017–18 reporting period. Therefore, the volumes for small catchment dams in 2016–17 are not directly comparable with the volumes reported for 2017–18. Each year presents the best estimate of the water harvested, used and lost, based on the best information that was available at the time. For more information, see Appendix E and chapter 6.1.2.

Table 6-182 Estimated small catchment dam information for the Wimmera basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	29,523	1,557	2,440	3,997
Registered/licensed commercial and irrigation	7,448	578	317	895
Total 2017–18	**36,971**	**2,136**	**2,757**	**4,893**
Total 2016–17	31,465	18,310	14,099	32,409

5. In-stream losses

The method used to estimate in-stream loss in the Wimmera basin in the 2017–18 accounts has been revised from previous accounts, as chapter 6.1.2 explains. This has decreased the in-stream loss estimate by 5% for 2017–18: the previous method would have estimated the in-stream loss to be 20,131 ML instead of 19,162 ML.

6.28.4 Compliance against entitlements

Compliance against water entitlements is reported in these accounts in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Under Grampians Wimmera Mallee Water’s Wimmera and Glenelg rivers bulk entitlement, the water corporation operates the Wimmera–Glenelg system headworks to supply water to towns and customers connected to the Wimmera Mallee Pipeline and to supply entitlements held by Coliban Water, Wannon Water and the VEWH.

The Wimmera–Glenelg system is unique, because the headworks harvest water from both the Glenelg and Wimmera river systems, and the volumes supplied to entitlement holders cannot be disaggregated between the two basins. The entitlement volumes and diversions are presented in this Wimmera basin chapter and are not presented in the Glenelg basin chapter.

Under Grampians Wimmera Mallee Water’s Willaura system bulk entitlement, the water corporation operates the Mt William system in the Wimmera basin, to supply water to Willaura and to supply water to Wannon Water for Glenthompson.

Wimmera – Key compliance points

- ✓ **There was no net increase to the total entitlement volume from the previous year.**
- ✓ **Total volume diverted (44,521 ML) was within the volume available for the year (220,641 ML).**
- ✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
- ✓ **Individual bulk entitlement holders complied with all provisions in their entitlements apart from:**
  - ✗ **water was taken from Lake Lonsdale to supply the CEWH, although this was not an authorised offtake point at the time. The Minister has since authorised offtake from Lake Lonsdale as per the process set out in the bulk entitlement, to assist in the future delivery of water to the CEWH**
  - ✗ **no approved metering plan has been implemented for *Bulk Entitlement (Willaura, Elmhurst and Buangor systems – GWMWater) Conversion Order 2012***
  - ✗ **no approved metering plan has been implemented for *Bulk Entitlement (Wimmera and Glenelg Rivers – GWMWater) Conversion Order 2010***

Entitlements in the Wimmera basin provide the basis for how water is shared in the basin. Rights to water in the Wimmera basin are outlined in Table 6-183.

Table 6-183 Entitlement volumes in the Wimmera basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Landsborough – Navarre) Conversion Order 2003	60
Bulk Entitlement (Willaura, Elmhurst and Buangor systems – GWMWater) Conversion Order 2012 (1)	
Urban commitments – Grampians Wimmera Mallee Water	408
Bulk Entitlement (Willaura system – Wannon Water) Conversion Order 2012	58
Subtotal: Bulk Entitlement (Willaura, Elmhurst and Buangor systems – GWMWater) Conversion Order 2012	**466**
Bulk Entitlement (Wimmera and Glenelg Rivers – GWMWater) Conversion Order 2010 (2)	
Wimmera and Glenelg rivers – Grampians Wimmera Mallee Water Wimmera Mallee Pipeline product	44,720
Supply by agreement – CEWH	28,000
Glenelg compensation flow	3,300

Water entitlement	Annual entitlement volume (ML)
Recreation [3]	3,090
Pipeline loss allowance	2,960
Bulk Entitlement (Wimmera and Glenelg Rivers – Coliban Water) Conversion Order 2010	300
Bulk Entitlement (Wimmera and Glenelg Rivers – Wannon Water) Conversion Order 2010	2,120
Wimmera and Glenelg Rivers Environmental Entitlement 2010 [4]	
Wimmera and Glenelg rivers environmental entitlement wetland product	1,000
Wimmera and Glenelg rivers environmental entitlement Wimmera Mallee Pipeline product	40,560
Subtotal: Wimmera and Glenelg Rivers Environmental Entitlement 2010	**41,560**
Subtotal: Bulk Entitlement (Wimmera and Glenelg Rivers – GWMWater) Conversion Order 2010	**126,050**
Take and use licences – unregulated surface water [5]	2,223
Total (30 June 2018)	**128,799**
Total (30 June 2017)	**128,804**

Notes

(1) Under Grampians Wimmera Mallee Water's Willaura system bulk entitlement, the water corporation operates the Mt William system in the Wimmera basin to supply water to Willaura and to supply water to Wannon Water for Glenthompson. This bulk entitlement also includes the Elmhurst and Buangor systems, which are physically located in the Hopkins basin.

(2) Under Grampians Wimmera Mallee Water's Wimmera and Glenelg rivers bulk entitlement, the water corporation operates the Wimmera Mallee system headworks to supply its own customers and the entitlements held by Coliban Water, Wannon Water, the VEWH and the CEWH.

(3) The *Bulk Entitlement (Wimmera and Glenelg Rivers) Conversion Order 2010* provides a 3,090 ML entitlement to supply 11 recreational lakes and weir pools from the Wimmera Mallee Pipeline each year. It supplies recreational lakes throughout the region that historically received water from the channel system before it was decommissioned.

(4) 2017–18 is the first year that the separate components of this entitlement have been reported in the accounts. This detail has been included to provide more clarity about the entitlement, and it does not represent a change in the entitlement. The 1,000 ML for wetlands is supplied from the Wimmera Mallee Pipeline each year; it supplies wetlands throughout the region that historically received water from the channel system before it was decommissioned.

(5) The total volume of licences in the Wimmera basin includes licences for irrigation as well as for domestic and stock purposes.

Table 6-184 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-184 Available water and take for the Wimmera basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Landsborough – Navarre	-	60	0	**60**	**0**
Willaura, Elmhurst and Buangor systems – Grampians Wimmera Mallee Water					
Urban commitments – Grampians Wimmera Mallee Water	-	408	0	**408**	**136**
Willaura system – Wannon Water	-	58	0	**58**	**45**
Diversion: Willaura, Elmhurst and Buangor systems – Grampians Wimmera Mallee Water					**181**
Wimmera and Glenelg rivers – Grampians Wimmera Mallee Water					
Grampians Wimmera Mallee Water Wimmera Mallee Pipeline product	82,653	36,223	0	**118,876**	**13,193**
Supply by agreement – CEWH	12,138	0	0	**12,138**	**3,108**
Glenelg compensation flow	2,826	825	0	**3,651**	**0**
Recreation	3,668	618	0	**4,286**	**2,091**
Pipeline loss allowance	6,445	2,960	0	**9,405**	**729**
Wimmera and Glenelg rivers – Coliban Water	378	243	0	**621**	**229**
Wimmera and Glenelg rivers – Wannon Water	5,481	1,717	0	**7,198**	**51**
Wimmera and Glenelg rivers environmental entitlement [1]	30,414	33,104	0	**63,518**	**24,518**
Diversion: Wimmera and Glenelg rivers [2]					**43,918**
Take and use licences – unregulated surface water	-	422	0	**405**	**422**
Total 2017–18	**144,003**	**76,638**	**0**	**220,623**	**44,521**
Total 2016–17	84,525	121,415	16	205,956	27,789

Notes

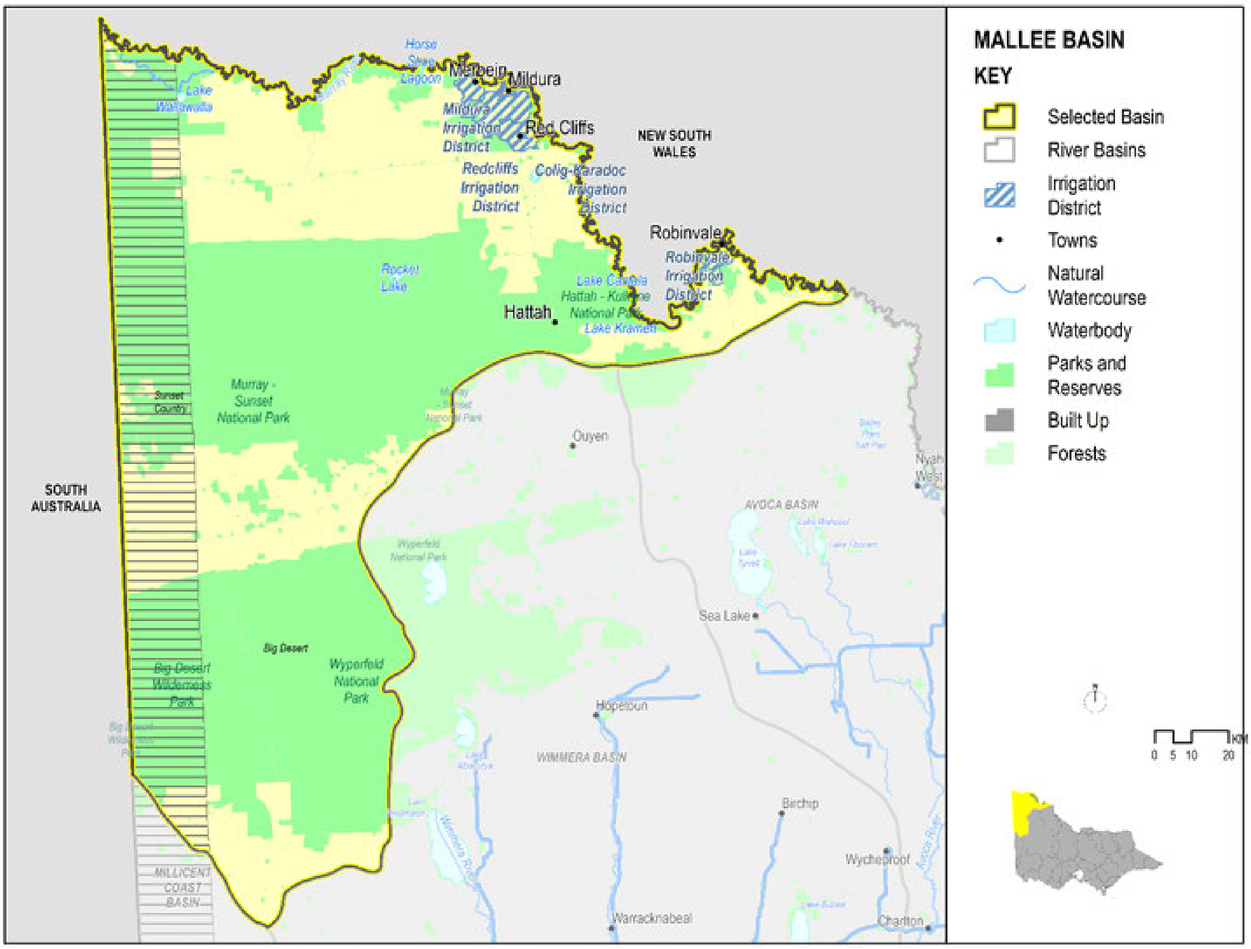
(1) Use against this environmental entitlement included 27,347 ML of water delivered in-stream — 16,347 ML in the Wimmera basin and 11,000 ML in the Glenelg basin — and 279 ML of water delivered off-stream to the Wimmera Mallee wetlands. The 16,347 ML delivered in-stream in the Wimmera basin is not included in the water balance in Table 6-179 as it does not reflect an actual diversion from the waterway.

(2) The water use reported in this line item represents the bulk diversion to supply primary entitlements under the Wimmera and Glenelg rivers system source bulk entitlement. It includes environment deliveries in-stream (27,347 ML) as well as environmental diversions off-stream (279 ML to wetlands).

6.29 Mallee basin

The Mallee basin (Figure 6-54) has few well-defined waterways. The Murray River forms the northern boundary of the basin, and for water accounting purposes it is only included in the water balance of the Murray basin (chapter 6.2).

Figure 6-54 Map of the Mallee basin



6.29.1 Management arrangements

Management of water in the Mallee basin is undertaken by various parties, the responsibilities of which Table 6-185 shows.

Table 6-185 Responsibilities for water resources management in the Mallee basin

Authority	Management responsibilities
Grampians Wimmera Mallee Water	• Supplies water to Murrayville and Cowangie
Lower Murray Water	• Supplies water from the Murray River to the Millewa waterworks district, Carwarp and Yelta
Mallee Catchment Management Authority	• Responsible for waterway and catchment management in the whole Mallee basin

6.29.2 2017–18 Water resource overview

In 2017–18, the northern half of the Mallee basin received between 60% and 80% of long-term average rainfall and the southern half between 80% and 100%.

Almost all surface water used in the Mallee basin is sourced from other basins.

No urban water-use restrictions applied in the Mallee basin in 2017–18, with all towns remaining on permanent water-saving rules throughout the year.

Water for the environment

In 2017–18, water for the environment in the Mallee basin comprised all water in the basin not allocated for consumptive use: this water also provides social, recreational and cultural benefits.

6.29.3 Water balance

Limited information is available for surface water availability and use, so a water balance has not been included for the Mallee basin.

1. Storages

There are no storages in the Mallee basin.

2. Catchment inflow

The Mallee basin has no well-defined streams other than the Murray River, which runs along the entire northern edge of the basin and has only a few small tributaries at various points close to the Murray. Since the Murray surface water reporting is covered in chapter 6.2, there is no surface water resource information presented for the Mallee basin.

There is no reliable estimate of surface flows in the Mallee basin to estimate the volume of water leaving the basin.

3. Recycled water

There are no wastewater treatment plants within the Mallee basin.

4. Small catchment dams

While there are some small catchment dams in the Mallee basin, no information about them is available, and they are not a significant source of water in the basin. Given the lack of information, the capacity of small catchment dams is assumed to be zero.

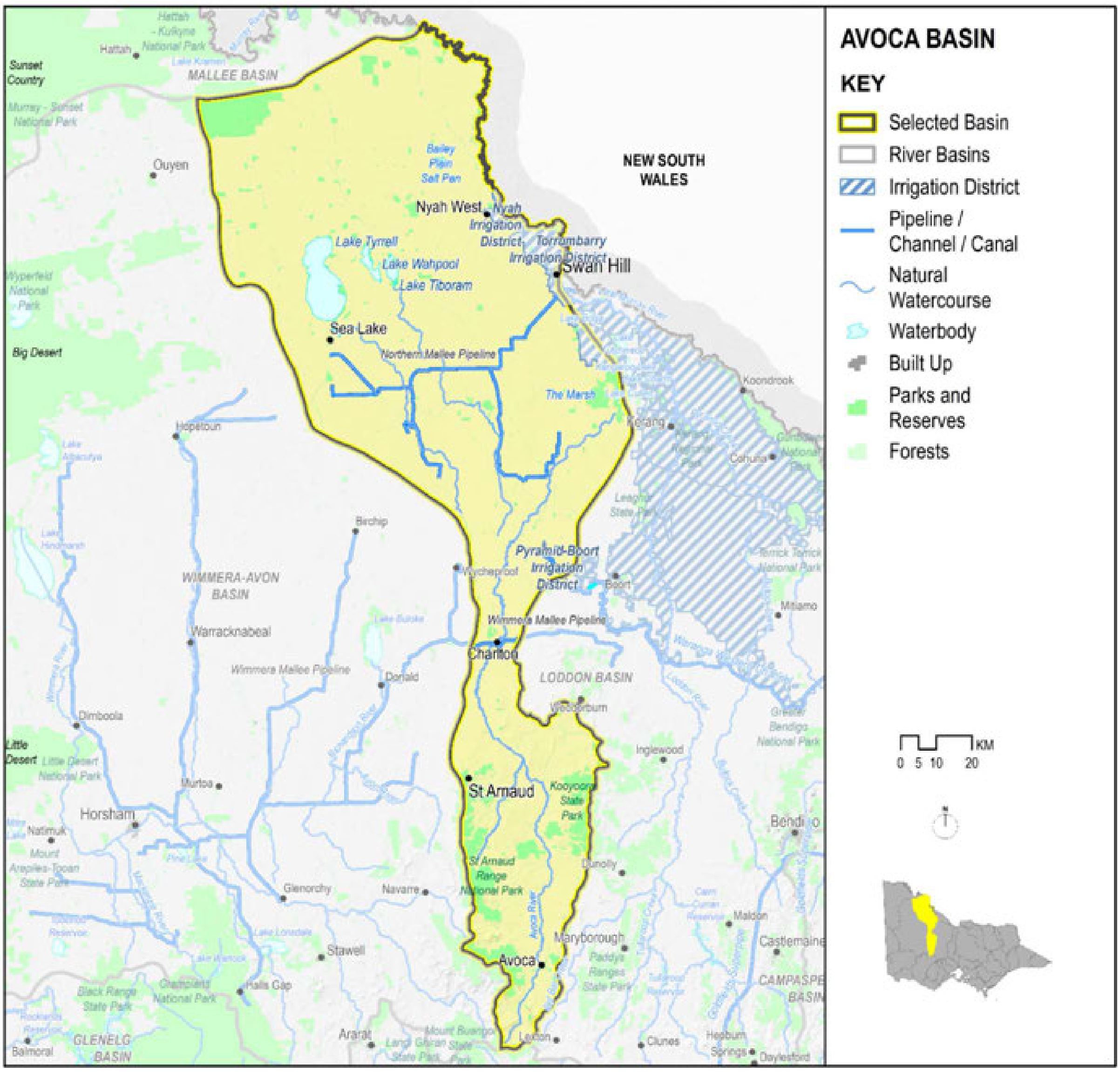
6.29.4 Compliance against entitlements

No bulk entitlements are supplied from surface water sourced from within the Mallee basin. The volume diverted under bulk entitlements for water supplied to the Mallee basin is presented in the water accounts for adjacent river basins.

6.30 Avoca basin

The Avoca basin (Figure 6-55) includes the Avoca River, small tributaries (such as Strathfillan Creek and Cherry Tree Creek) and minor watercourses which drain internally (such as Tyrrell Creek, which terminates in Lake Tyrrell). The Avoca River flows into the Kerang Lakes at Lake Bael Bael. For the purposes of these accounts, the Avoca basin excludes Swan Hill and the Torrumbarry Irrigation Area, which are supplied from the Murray River.

Figure 6-55 Map of the Avoca basin



6.30.1 Management arrangements

Management of water in the Avoca basin is undertaken by various parties, the responsibilities of which Table 6-186 shows.

Table 6-186 Responsibilities for water resources management in the Avoca basin

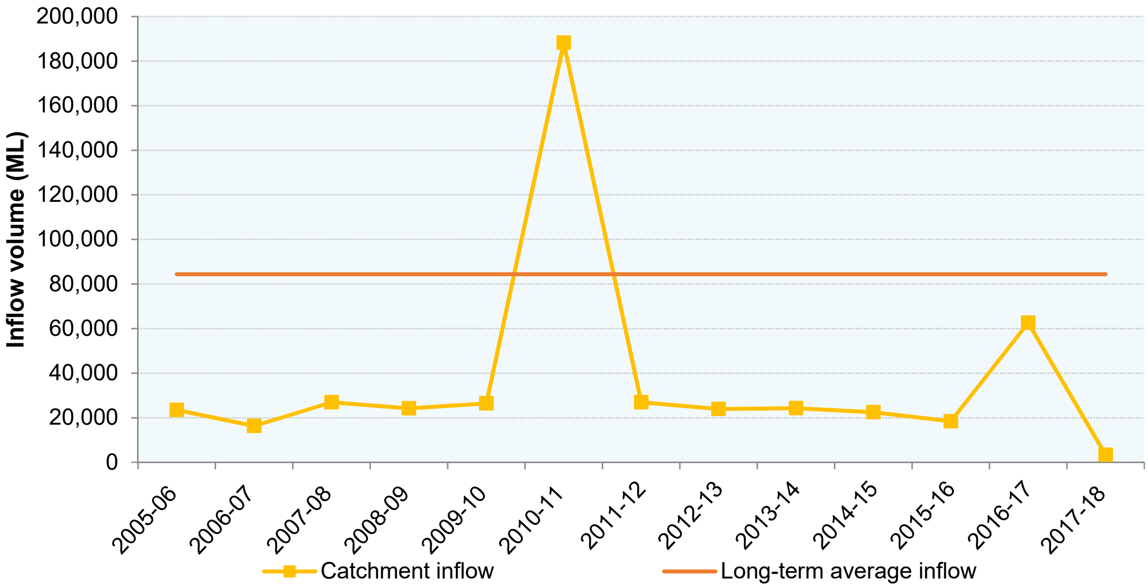
Authority	Management responsibilities
Central Highlands Water	• Supplies towns in the southern part of the Avoca basin including Avoca and Redbank
Grampians Wimmera Mallee Water	• Provides domestic and stock supplies to farms via the Wimmera Mallee Pipeline and the Northern Mallee Pipeline • Manages licensing • Supplies towns in the northern part of the Avoca basin including St Arnaud, Charlton, Sea Lake and Quambatook (water sourced from outside the Avoca basin)
Goulburn-Murray Water	• Supplies water from the Goulburn basin in bulk to Grampians Wimmera Mallee Water for Quambatook via the Normanville supply system
North Central Catchment Management Authority	• Responsible for waterway and catchment management in the Avoca basin

6.30.2 2017–18 Water resource overview

Rainfall across the Avoca basin in 2017–18 was mostly between 60% and 80% of the long-term average, with areas in the north-east, north-west and the southern tip of the basin receiving between 80% and 100% of average rainfall.

The long-term average used in the 2017–18 accounts has been revised from previous accounts and is now an average of post-1975 streamflow, as chapter 2.2 explains. Catchment inflows in 2017–18 were 4% of the revised long-term average annual volume of 84,395 ML: less than the inflows recorded in 2016–17, which were 74% of the revised long-term average. Unlike the previous year, where 37,894 ML water reached the terminal lakes in the north of the basin, in 2017–18 no outflows were recorded.

Figure 6-56 Storage volumes and catchment inflows in the Avoca basin



In 2017–18, 950 ML of water was diverted for consumptive purposes (town, domestic and stock, irrigation and commercial supply). This was less than the 9,836 ML reported in the previous year. The vast majority (9,765 ML) of last year's diversion was the reporting of small catchment dam use, which has reduced this year to 861 ML, due to improved hydrological modelling. For more information, see Appendix E.

All irrigation diversions from the Avoca River were banned for the entirety of 2017–18. Licensed diversions for domestic and stock use were not banned.

There were no urban restrictions applied within the Avoca basin in 2017–18, with all towns in the basin remaining on permanent water-saving rules throughout the year.

Water for the environment

Environmental assets that rely on water in the Avoca basin include:

- the Avoca River, with red gums and a floodplain system in the lower Avoca and grassy woodland in the upper Avoca
- the lower Avoca grasslands, a unique, largely intact mosaic of floodplain associated with grassland and grassy woodland communities and significant flora and fauna values.

In 2017–18, water for the environment in the Avoca basin comprised:

- water set aside for the environment through flow-sharing arrangements set out in consumptive bulk entitlements held by Central Highlands Water
- water set aside for the environment through the operation of passing flow conditions on licensed diversions
- all other water in the basin not allocated for consumptive use: this water also provides social, recreational and cultural benefits.

6.30.3 Water balance

The total volumes of water available and supplied from water resources in the Avoca basin in 2017–18 are shown in Table 6-187.

Table 6-187 Water balance – Avoca basin

Water account component	Note	2017–18 (ML)	2016–17 (ML)
Major on-stream storage			
Volume in storage at start of year		-	-
Volume in storage at end of year		-	-
Change in storage		**-**	**-**
Inflows			
Catchment inflow	1	3,366	62,597
Rainfall on major storages		-	-
Treated wastewater discharged back to river	2	0	94
Total inflows		**3,366**	**62,691**
Outflows			
Diversions			
Urban diversions		47	31
Licensed diversions from unregulated streams		42	40
Small catchment dams	3	861	9,765
Total diversions		***950***	***9,836***
Losses			
Evaporation losses from major storages		-	-
Evaporation from small catchment dams	3	1,066	8,549
In-stream infiltration to groundwater, flows to floodplain and evaporation		1,350	6,413
Total losses		***2,416***	***14,962***
Water passed at outlet of basin			
Avoca River flow at Sandhill Lake Road (outflow to terminal lakes)		0	37,894
Avoca River overflow from the terminal lakes to the Kerang Lakes		0	0
Total water passed at outlet of basin		***0***	***37,894***
Total outflows		**3,366**	**62,691**

Notes to the water balance

1. Catchment inflow

Catchment inflow is the balancing item in this water balance. It is the difference between the total outflows and the known inflows.

2. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-188 lists the wastewater treatment plants in the Avoca basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance. In 2017–18, no water was discharged to the environment in the Avoca basin.

Table 6-188 Volume and use of recycled water in the Avoca basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Avoca	39	39	100%	0	39	0	0	0	0
Charlton	43	6	13%	0	6	0	0	0	37
Sea Lake	29	0	0%	0	0	0	0	0	29
St Arnaud	147	87	59%	40	47	0	0	0	59
Total 2017–18	**258**	**132**	**51%**	**40**	**92**	**0**	**0**	**0**	**125**
Total 2016–17	297	79	27%	35	44	0	0	94	124

3. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-189 provides information about small catchment dams in the basin.

New hydrological modelling has provided a more-accurate measure of usage and harvested volumes for the 2017–18 reporting period. Therefore, the volumes for small catchment dams in 2016–17 are not directly comparable with the volumes reported for 2017–18. Each year presents the best estimate of the water harvested, used and lost, based on the best information that was available at the time. For more information, see Appendix E and chapter 6.1.2.

Table 6-189 Estimated small catchment dam information for the Avoca basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	9,483	432	827	1,259
Registered/licensed commercial and irrigation	5,183	429	239	668
Total 2017–18	**14,667**	**861**	**1,066**	**1,927**
Total 2016–17	15,788	9,765	8,549	18,314

6.30.4 Compliance against entitlements

Compliance against water entitlements is reported in these accounts in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Avoca – Key compliance points
✓ **There was no net increase to the total entitlement volume from the previous year.**
✓ **The total volume diverted (89 ML) was within the volume available for the year (2,967 ML).**
✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlement volumes provide the basis for how water is shared in the basin. Rights to water in the basin are outlined in Table 6-190.

Table 6-190 Entitlement volumes in the Avoca basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Amphitheatre) Conversion Order 2003	25
Bulk Entitlement (Avoca) Conversion Order 2003	233
Bulk Entitlement (Redbank) Conversion Order 2003	20
Take and use licences – unregulated surface water	2,689
Total (30 June 2018)	**2,967**
Total (30 June 2017)	**2,967**

Table 6-191 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-191 Available water and take for the Avoca basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Amphitheatre	-	25	0	**25**	**18**
Avoca	-	233	0	**233**	**30**
Redbank	-	20	0	**20**	**0**
Take and use licences – unregulated surface water	-	2,689	0	**2,689**	**42**
Total 2017–18	**-**	**2,967**	**0**	**2,967**	**89**
Total 2016–17	-	2,967	0	2,967	71

7. Groundwater catchment accounts

7.1 Overview

7.1.1 Introduction

This chapter outlines the approach used for presenting the accounts information in the groundwater catchment. It explains facts and assumptions about, and limitations to, the information presented. *The groundwater catchment accounts should be read in conjunction with the information presented in this chapter.*

The groundwater catchment accounts are compiled from information obtained from:

- the Victorian Water Register
- the Victorian Water Measurement Information System
- responses to requests for data from water corporations and major users of water
- hydrogeologic information from selected groundwater monitoring sites
- water corporations' groundwater catchment statements, annual reports and related documents.

7.1.2 Groundwater resources

In 2012, the Victorian Government developed a framework for the management and reporting of groundwater resources (chapter 1.3.2). The framework comprises three levels for managing and reporting on groundwater. In decreasing order of area extent they are the:

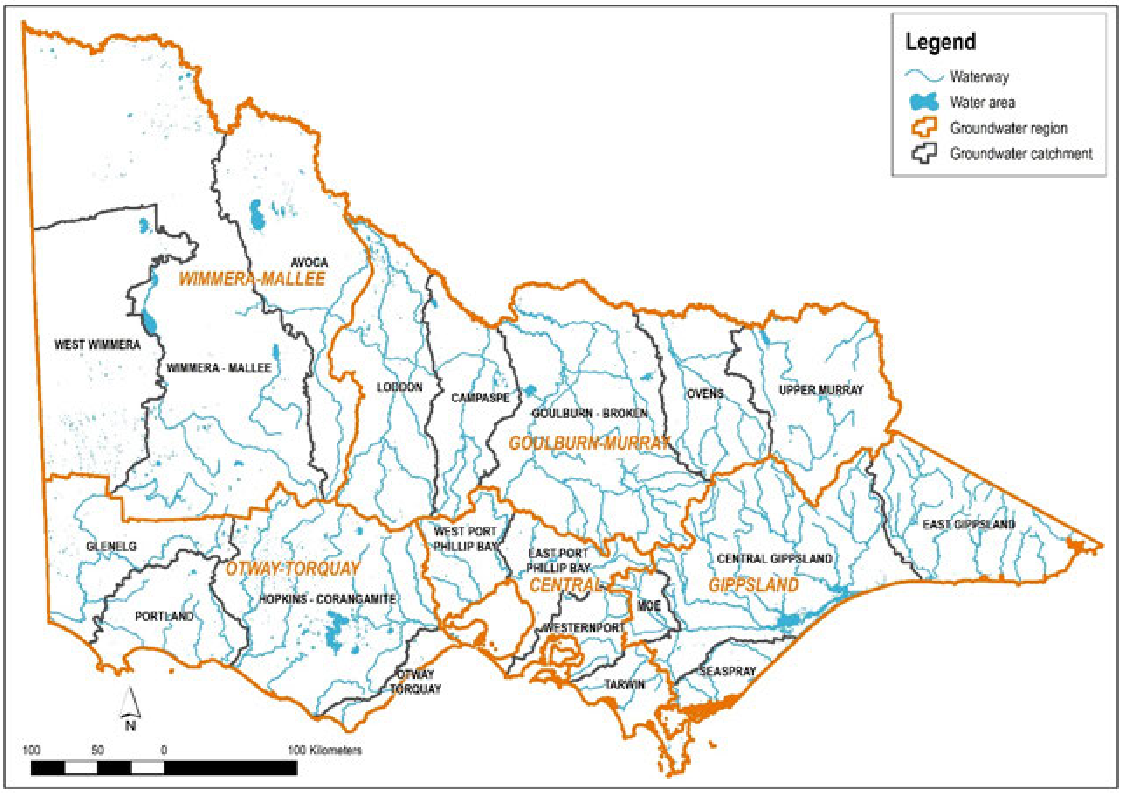
- groundwater regions
- groundwater catchments
- GMUs.

Victoria's groundwater resources are contained in five major groundwater regions. These are in partly based on hydrogeological understanding, but are also to align with administration boundaries. For instance, most of the Goulburn–Murray region and the Wimmera–Mallee region are hydrogeologically part of the Murray–Darling basin but extend outside this basin to incorporate areas managed and administered by Goulburn Murray Water and Grampians Wimmera Mallee Water respectively.

For management and reporting purposes, each groundwater region has several groundwater catchments, shown in **Figure 7-1**. A groundwater catchment approximates the surface water basin with adjustments based on knowledge and assumptions around groundwater flow divides. The Victorian groundwater regions and their catchments used for reporting purposes are:

- in the north and north-east is the **Goulburn–Murray region (Murray–Darling basin)**, which covers the Loddon, Campaspe, Goulburn–Broken, Ovens and Upper Murray groundwater catchments
- in the south-east is the **Gippsland region**, which covers the East Gippsland, Central Gippsland, Moe and Seaspray groundwater catchments
- in the south is the **Central region**, several regions grouped for management purposes which cover the West Port Phillip Bay, East Port Phillip Bay, Westernport and Tarwin groundwater catchments
- in the south-west is the **Otway–Torquay region**, which covers the Glenelg, Portland, Hopkins–Corangamite and Otway–Torquay groundwater catchments
- in the north-west is the **Wimmera–Mallee region (Murray–Darling basin)**, which covers the Wimmera–Mallee, West Wimmera and Avoca groundwater catchments.

Figure 7-1 Groundwater regions and catchments



Within the groundwater catchments are the smaller management units — the GMUs — which are classified as WSPAs and GMAs. Areas outside these units were previously referred to as unincorporated areas (UAs) (as outlined in chapter 1). Generally, a groundwater catchment includes several GMUs where the geographical boundaries of the GMU are contained within and/or aligned with the groundwater catchment boundaries. There are a few exceptions (such as the South West Limestone GMA, Central Victorian Mineral Springs GMA and Shepparton Irrigation Region GMA, which straddle several groundwater catchments) (chapters 7.5.2, 7.5.3 and 7.5.4).

Various statutory and non-statutory mechanisms are used for planning, allocating and managing groundwater. Licensing is the fundamental basis for allocating groundwater. The total volume of groundwater that may be licensed in a GMU is referred to as the PCV. PCVs are declared by the Minister for Water through an order published in the government gazette. Adaptive management occurs through take and use licences, single-source urban water bulk entitlements, statutory groundwater management plans, local management plans, groundwater catchment statements and water resource strategies. All management instruments are developed in consultation with local stakeholders including customer groups, environmental representatives and relevant government agencies.

See chapter 1.1.2 for more information about the management of groundwater resources.

7.1.3 Groundwater catchment reporting

Information about groundwater in 2017–18 is presented in this chapter for each of the 19 groundwater catchments. There are two subchapters within each groundwater catchment:

- groundwater resources overview
- groundwater entitlements and use.

7.1.3.1 Groundwater resources overview

This section summarises the management arrangements and GMUs that may be located in the groundwater catchment.

This section also provides a snapshot of activity in the groundwater catchment for 2017–18 summarising groundwater level trends in GMUs, restrictions and water use.

7.1.3.2 Groundwater entitlements and use

The tables in this section detail the 2017–18:

- licensed groundwater volumes and use
- domestic and stock bores and estimated use
- urban use.

Licensed groundwater volumes and use

The table in this section reports the total volume of take and use licences held by individual customers in GMUs and outside management units, by catchment. This represents the total volume of water that could be extracted for the water year plus all licensed use. This total includes urban use and various other uses where such uses are allowed in a groundwater licence.

Number of domestic and stock bores and estimated use

The table in this section presents the number of bores used for domestic and stock purposes in each GMU and outside management units, by groundwater catchment, together with the estimated groundwater use for this purpose. This use is permitted under section 8 of the *Water Act 1989*, which grants private rights to take a small volume of water for domestic household and stock watering purposes from surface and groundwater under certain circumstances without a licence. Where domestic and stock use forms part of a groundwater licence, the estimated use is not presented in this table: it has been accounted for in the total licensed groundwater use, as stated above.

Estimated use has been calculated based on an assumption of 2 ML per bore per year in groundwater areas managed by Goulburn Murray Water and Grampians Wimmera Mallee Water and 1.5 ML per bore per year in groundwater areas managed by Southern Rural Water (except for the Nepean GMA, which was estimated at 1 ML per bore per year; and Stratford GMA, which was estimated at 2 ML per year).

The number of domestic and stock bores recorded for each GMU includes all bores registered in the Water Measurement Information System that are less than 30 years old, as this is the expected average life of a bore. Bore depths (where recorded) have been taken into account to ensure that domestic and stock bores are assigned appropriately. To account for domestic and stock bores, bores are first assigned to the spatial and depth locations of the GMU where this information is available. Where spatial and/or depth locations are not available, the bores are assigned to outside the GMU: that is, to previously known unincorporated areas or UAs.

Urban groundwater volumes and metered use

The table in this section reports on take and use licences held by urban water corporations to supply towns within their service area. The volumes and metered use reported in this table reflect the portion of total licensed groundwater volumes and use stated above that is attributable to urban supply. The volumes are not an additional resource or use in the catchment.

7.2 Goulburn–Murray groundwater region

The Goulburn–Murray groundwater region is located in north-east Victoria. It borders the Gippsland region to the south-east, the Central and Otway–Torquay regions to the south and the Wimmera–Mallee region to the west.

The hydrogeology of the region can be broadly subdivided into two distinct geological areas: the southern highlands of bedrock with sedimentary valleys and the northern plains with layers of sedimentary aquifers.

In the south, the highlands feature exposed bedrock and valleys of eroded material that form the Quaternary Aquifer. This thin, shallow aquifer is comprised of sand, colluvium, fluvial sands, gravels, clay and silts and is found in upland valleys (such as Alexandra, Yea and Flowerdale). Water is also held in the Mesozoic and Palaeozoic bedrock, which is comprised of sedimentary fractured rock. Bedrock is close to the surface near Jamieson, Mansfield, Marysville, Kilmore and Seymour and to the east is increasingly buried deeper. These groundwater resources are generally low-yielding, unless a fracture in the rock is intercepted.

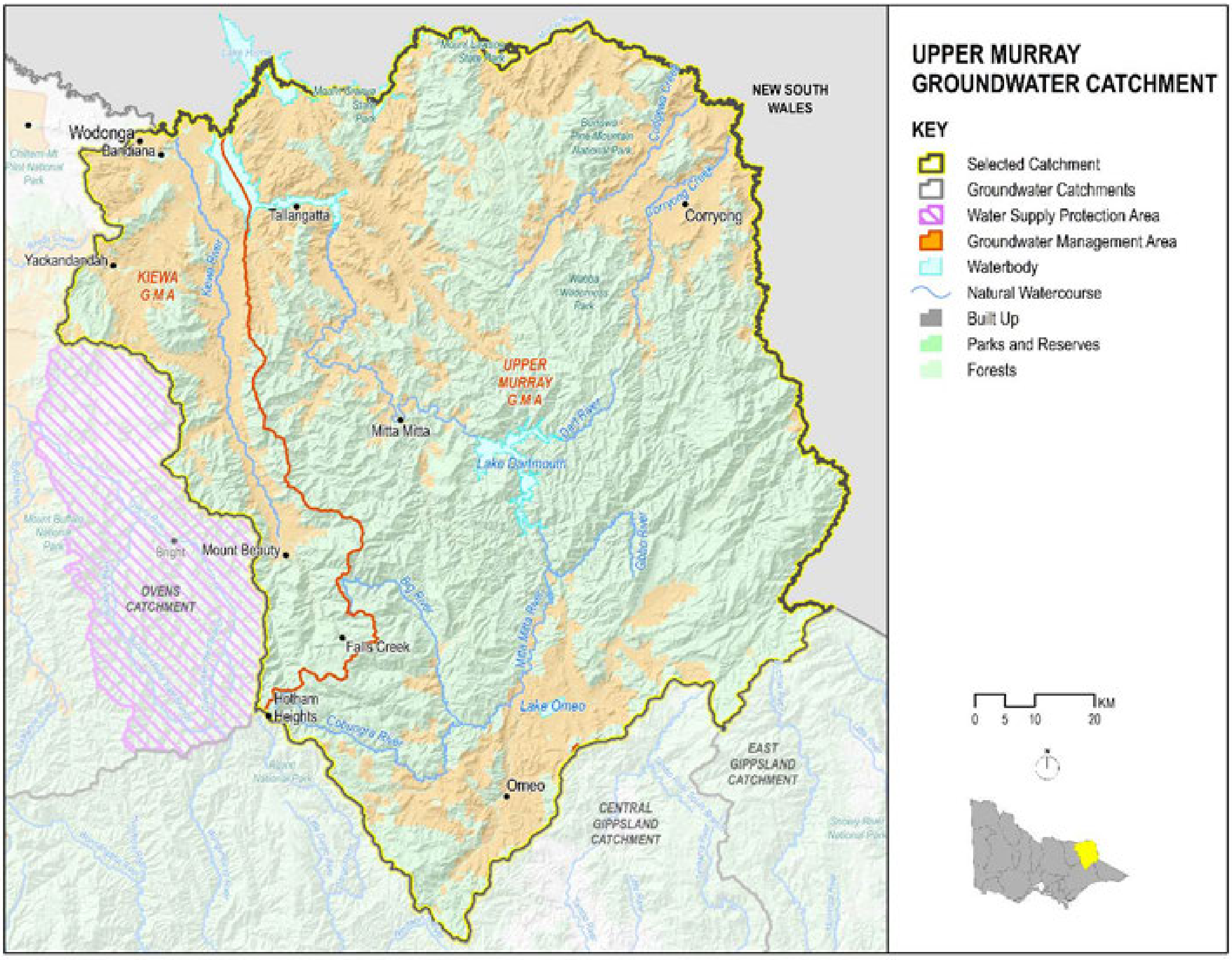
In the north, the plain of the Goulburn–Murray region gradually thickens into several geological layers.

- The Upper Tertiary Quaternary Aquifer of the Shepparton formation is made of layered clay, sands and silt. It appears north of Seymour and runs to Nathalia, Barmah and Numurkah. Along the Murray, the Upper Tertiary Quaternary Aquifer overlies the Calvil Formation Upper Tertiary Aquifer fluvial, containing fluvial sand, gravel and clay. These are major groundwater resources in the region.
- The Lower Tertiary Aquifers of the Renmark formation appear in pockets to the north, near Nathalia and Barmah. They comprise sand, gravel, clay, silt and minor coal. These are major groundwater resources in the region.
- Cretaceous Permian sediments made of fractured rock, sand and minor coal. They appear from Shepparton to parts of the north near Nathalia and Numurkah.
- Mesozoic and Palaeozoic bedrock, which comprises sedimentary fractured rock.

7.2.1 Upper Murray groundwater catchment

The Upper Murray groundwater catchment is located in north-east Victoria (Figure 7-2). The Upper Murray groundwater catchment extends from the Victorian Alps to the Murray River. Major rural centres in the catchment include Omeo, Tallangatta and Corryong.

Figure 7-2 Map of the Upper Murray groundwater catchment



7.2.1.1 Groundwater resources overview

Groundwater resources in the Upper Murray groundwater catchment are managed by Goulburn Murray Water, which carries out the development and implementation of groundwater management plans. Goulburn Murray Water also issues licences for groundwater use and bore construction, and it administers domestic and stock use. The Upper Murray catchment is part of the Murray–Darling basin, and groundwater management arrangements are subject to the requirements of the Murray–Darling Basin Plan.

The Upper Murray groundwater catchment contains the Upper Murray and Kiewa GMAs and a small part of the Upper Ovens WSPA, which is mostly contained in the Ovens groundwater catchment. Groundwater resources supply licence entitlements, domestic and stock use and the town of Dinner Plain.

The groundwater level trends for 2017–18 are presented in Table 7-1. The groundwater trends across the groundwater catchment were categorised as stable for the majority of 2017–18, with the Upper Ovens WSPA recording rising levels during the year.

Table 7-1 Upper Murray groundwater level trends

Groundwater management unit	Groundwater level trend 2017–18				Groundwater level trend June 2017
	Sep-17	Dec-17	Mar-18	Jun-18	
Water supply protection area					
Upper Ovens	Rising	Stable	Rising	**Stable**	**Stable**
Groundwater management area					
Kiewa	Stable	Stable	Stable	**Stable**	**Stable**
Upper Murray	Stable	Stable	Stable	**Stable**	**Stable**

In 2017–18, 872 ML of water was diverted for consumptive purposes — for town, irrigation and commercial supply — which was slightly more than the 846 ML diverted in the previous year. Of this volume, 46 ML was diverted for urban use.

An additional 916 ML was estimated to have been used for domestic and stock purposes.

7.2.1.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs are shown in Table 7-2. Groundwater use increased in 2017–18, compared to 2016–17.

Table 7-2 Licensed groundwater volumes and use in the Upper Murray groundwater catchment

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2017–18	Total licensed groundwater use (ML) 2016–17
Kiewa GMA	All depths	3,114	422	405
Upper Murray GMA	All depths	3,483	450	440
Total		**6,597**	**872**	**846**

An estimate of domestic and stock groundwater use is shown in Table 7-3. A number of groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed volume in Table 7-2.

Table 7-3 Number of domestic and stock bores and estimated use in the Upper Murray groundwater catchment

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 2 ML per bore)
Kiewa GMA	266	532
Upper Murray GMA	192	384
Total 2017–18	**458**	**916**
Total 2016–17	473	946

Groundwater is used to provide the urban water supply to Dinner Plain. The licensed entitlements and metered use in 2017–18 for this supply are presented in Table 7-4.

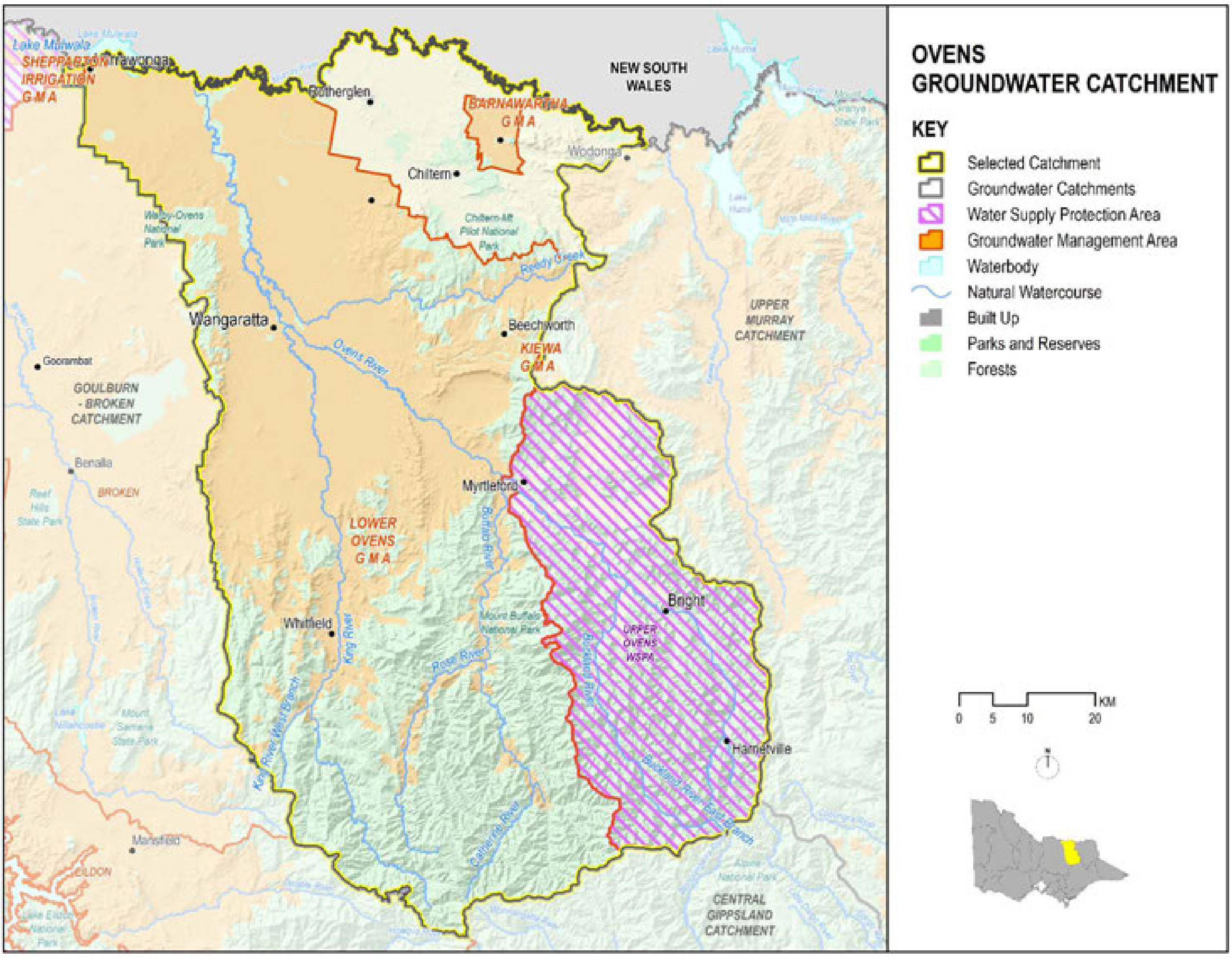
Table 7-4 Urban groundwater use in the Upper Murray groundwater catchment

Town supplied	Licensed volume (ML)	Metered use 2017–18 (ML)	Metered use 2016–17 (ML)
Dinner Plains	120	46	41
Total	**120**	**46**	**41**

7.2.2 Ovens groundwater catchment

The Ovens groundwater catchment is in northern Victoria (Figure 7-3). It extends from the Great Dividing Range in the south to the Murray River in the north.

Figure 7-3 Map of the Ovens groundwater catchment



7.2.2.1 Groundwater resources overview

Groundwater resources in the Ovens groundwater catchment are managed by Goulburn Murray Water, which is responsible for developing and implementing groundwater management plans. Goulburn Murray Water also issues licences for groundwater use, bore construction and surface water diversions, and it administers domestic and stock use. The Ovens groundwater catchment is part of the Murray–Darling basin, and groundwater management arrangements are subject to the requirements of the Murray–Darling Basin Plan.

The Ovens groundwater catchment contains the Barnawartha GMA, Lower Ovens GMA and Upper Ovens WSPA. The *Upper Ovens WSPA Management Plan* manages groundwater in the unconsolidated sedimentary aquifer as a connected system with surface water. Groundwater resources supply licence entitlements and domestic and stock use. Groundwater is also used as a backup supply for Wangaratta and four other towns in the area.

The groundwater level trends for 2017–18 are presented in Table 7-5. In 2017–18, the Upper Ovens WSPA groundwater level trend was classified as rising for part of the year and ended with a stable trend. The GMA trends were categorised as stable for the whole year.

Table 7-5 Ovens groundwater level trends

Groundwater management unit	Groundwater level trend 2017–18				Groundwater level trend June 2017
	Sep-17	Dec-17	Mar-18	Jun-18	
Water supply protection area					
Upper Ovens	Rising	Stable	Rising	**Stable**	**Stable**
Groundwater management area					
Barnawartha	Stable	Stable	Stable	**Stable**	**Stable**
Lower Ovens	Stable	Stable	Stable	**Stable**	**Declining**

Note

(1) The Upper Ovens WSPA is partly contained within the Upper Murray groundwater catchment.

In 2017–18, 7,840 ML of water was diverted for consumptive purposes — for town, irrigation and commercial supply — which was more than the 7,535 ML diverted in the previous year. Of this volume, 176 ML was diverted for urban use.

An additional 3,686 ML was estimated to have been used for domestic and stock purposes.

7.2.2.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs are shown in Table 7-6. Groundwater use increased in 2017–18, compared to 2016–17.

Table 7-6 Licensed groundwater volumes and use in the Ovens groundwater catchment

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2017–18	Total licensed groundwater use (ML) 2016–17
Barnawartha GMA	All depths	375	9	6
Lower Ovens GMA	All depths	19,905	5,758	5,839
Upper Ovens WSPA	All depths	3,650	977	970
Outside management units	-	2,294	1,096	720
Total		**26,224**	**7,840**	**7,535**

An estimate of domestic and stock groundwater use is shown in Table 7-7. Several groundwater licences also incorporate domestic and stock use and in these cases the use from these bores is reported in the licensed volume in Table 7-6.

Table 7-7 Number of domestic and stock bores and estimated use in the Ovens groundwater catchment

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 2 ML per bore)
Barnawartha GMA	24	48
Lower Ovens GMA	1,452	2,904
Upper Ovens WSPA	248	496
Outside management units	119	238
Total 2017–18	**1,843**	**3,686**
Total 2016–17	1,914	3,828

Groundwater in the Ovens groundwater catchment is an available urban water supply option for Barnawartha and as a backup urban water supply for Bright, Chiltern, Springhurst and Wangaratta. The volumes of licensed entitlements and metered use for these groundwater supplies are shown in Table 7-8.

In 2017–18, no groundwater was supplied to Barnawartha, Chiltern or Springhurst. Urban groundwater supply to Bright and Wangaratta in 2017–18 increased from the previous year.

Table 7-8 Urban groundwater volumes and metered use in the Ovens groundwater catchment

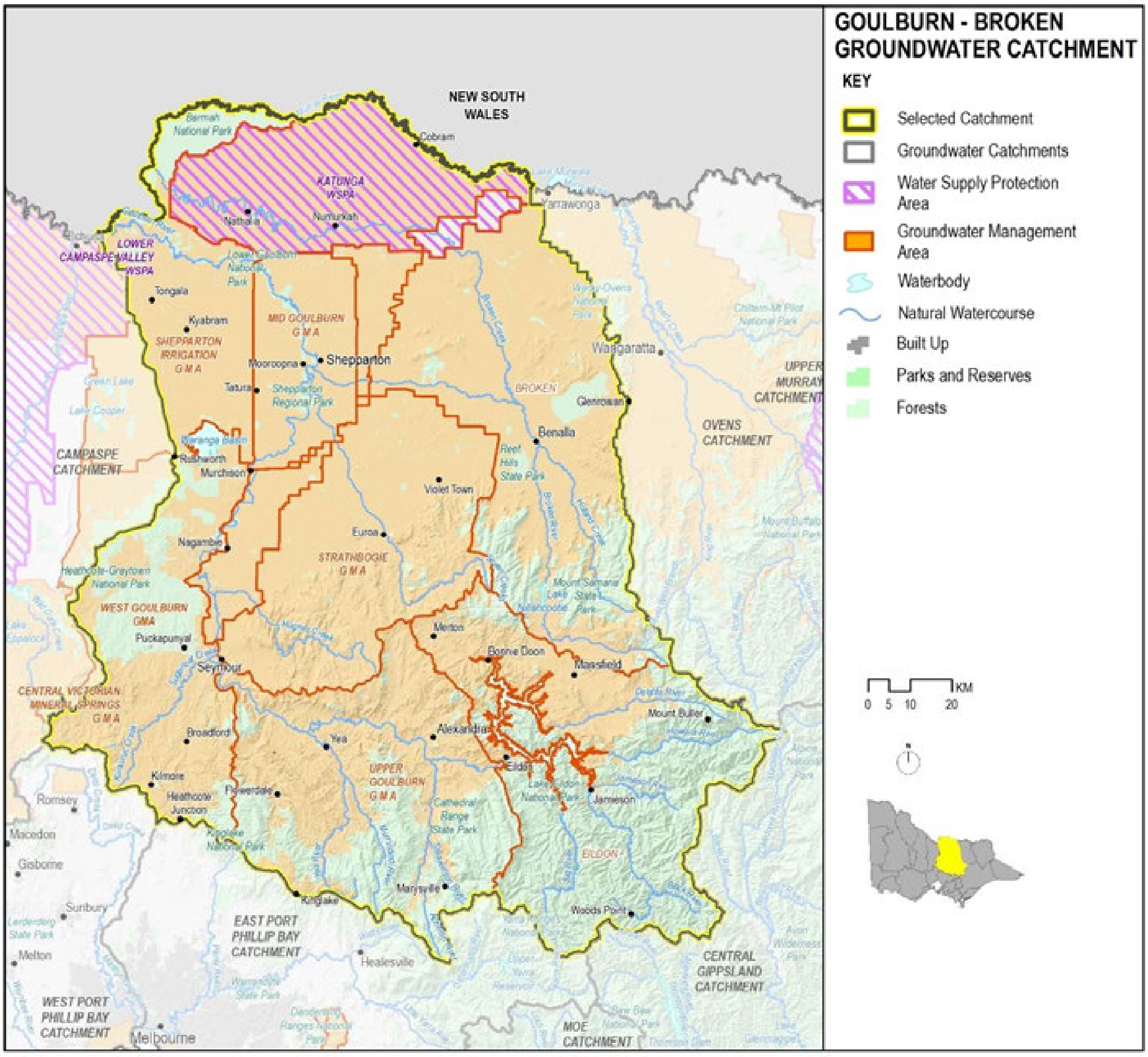
Town supplied	Licensed volume (ML)	Metered use 2017–18 (ML)	Metered use 2016–17 (ML)
Barnawartha	293	0	0
Bright	75	37	38
Chiltern	25	0	0
Moyhu (1)	0	0	0
Springhurst	20	0	0
Wangaratta	680	139	72
Total	**1,093**	**176**	**110**

Note
(1) The licence for Moyhu expired in 2017 and was not renewed.

7.2.3 Goulburn–Broken groundwater catchment

The Goulburn–Broken groundwater catchment is in northern Victoria (Figure 7-4). The hydrogeology of this groundwater catchment includes two distinct geological regions — the highlands of bedrock with sedimentary valleys in the south and the plains with layers of sedimentary aquifers in the north.

Figure 7-4 Map of the Goulburn–Broken groundwater catchment



7.2.3.1 Groundwater resources overview

Groundwater resources in the Goulburn–Broken groundwater catchment are managed by Goulburn Murray Water, which is responsible for developing and implementing groundwater management plans. Goulburn Murray Water also issues licences for groundwater use, bore construction and surface water diversions, and it administers domestic and stock use. The Goulburn–Broken groundwater catchment is part of the Murray–Darling basin and groundwater management arrangements are subject to the requirements of the Murray–Darling Basin Plan.

The Goulburn–Broken groundwater catchment includes the Mid Goulburn GMA, most of the Shepparton Irrigation Region GMA (which also extends into the Campaspe groundwater catchment), the Strathbogie GMA, the Upper Goulburn GMA, the Broken GMA, the Eildon GMA, the West Goulburn GMA and the Katunga WSPA. The local management plan for the West Goulburn GMA was approved and published on 28 July 2017.

Groundwater resources supply irrigation, domestic and stock use and urban use in Goorambat, Katunga and Strathmerton.

The groundwater level trends for 2017–18 are presented in Table 7-9. The trends varied from declining to rising across the GMUs within the Goulburn–Broken catchment with most ending 2017–18 with a stable trend, except the Mid Goulburn GMA and the Katunga WSPA.

Although there are no observation bores currently monitoring groundwater levels in the Eildon GMA, historical records indicate that groundwater levels in both aquifers of this GMA are generally within 5 m of the ground surface and fluctuate in response to rainfall. Goulburn Murray Water reported that rainfall in the Eildon GMA in 2017–18 was close to average.

Table 7-9 Goulburn–Broken groundwater level trends

	Groundwater level trend 2017–18				Groundwater level trend June 2017
	Sep-17	Dec-17	Mar-18	Jun-18	
Water supply protection area					
Katunga	Declining	Declining	Declining	**Declining**	**Declining**
Groundwater management area					
Broken	Stable	Stable	Stable	**Stable**	**Stable**
Mid Goulburn	Declining	Declining	Declining	**Declining**	**Declining**
Shepparton Irrigation Region (1)	Stable	Stable	Stable	**Stable**	**Rising**
Strathbogie	Stable	Stable	Stable	**Stable**	**Stable**
Upper Goulburn	Declining	Declining	Rising	**Stable**	**Stable**
West Goulburn (2)	Stable	Stable	Stable	**Stable**	-

Notes
(1) The Shepparton Irrigation Region GMA is partly contained within the Campaspe groundwater catchment.
(2) The West Goulburn GMA is partly contained within the Campaspe groundwater catchment.

In 2017–18, 108,735 ML of water was diverted for consumptive purposes — for town, irrigation and commercial supply — which was more than the 81,060 ML diverted in the previous year. Of this volume, 38 ML was diverted for urban use.

An additional 7,346 ML was estimated to have been used for domestic and stock purposes.

7.2.3.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs are shown in Table 7-10. Extractions from the Katunga WSPA were limited to 70 percent of licensed entitlement volume in the beginning of 2017–18. This increased to 100 percent in September 2017, the first time since the plan was implemented in 2006. Unlike the previous year, groundwater use was higher in 2017–18 than in 2016–17.

Table 7-10 Licensed groundwater volumes and use in the Goulburn–Broken groundwater catchment

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2017–18	Total licensed groundwater use (ML) 2016–17
Broken GMA (1)	See note 1	2,801	478	388
Eildon GMA	<=200 m	598	189	180
Katunga WSPA	>25	60,219	31,973	22,528
Mid Goulburn GMA	Zone 1070: >25 Zone 1071: All depths	12,470	3,336	1,786
Shepparton Irrigation Region GMA (2) (3)	<=25	172,152	69,986	53,569
Strathbogie GMA	<=250 m	1,417	457	468
Upper Goulburn GMA	<=250 m	6,064	993	1,034
West Goulburn GMA		2,814	1,205	0
Outside management units	-	209	118	1,107
Total		**258,744**	**108,735**	**81,060**

Notes
(1) The management plan for the Broken GMA covers groundwater resources to a depth of 200 m. The northwest of the Broken GMA is overlain by the Shepparton Irrigation Region (SIR) GMA. Where it overlaps with the SIR GMA, the Broken GMA covers groundwater resources at depths greater than 25 m from the surface of the ground.
(2) The SIR GMA extends into the Campaspe groundwater catchment; an additional 16,294 ML of entitlement volume is reported in the Campaspe catchment account (Table 7-14). The total entitlement volume for the SIR GMA as at 30 June 2018 was 188,446 ML.
(3) Groundwater use in the SIR GMA is estimated at the end of each season using a method which considers annual use by a subset of SIR GMA licensed groundwater users that are metered, the volume of metered groundwater use in the Katunga Water Supply Protection Area and spring rainfall. This volume has been split between the Campaspe and Goulburn–Broken catchments as a proportion of the entitlement volume.

An estimate of domestic and stock groundwater use is shown in Table 7-11. Several groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed volume in Table 7-10.

Table 7-11 Number of domestic and stock bores and estimated use in the Goulburn–Broken groundwater catchment

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 2 ML per bore)
Broken GMA	400	800
Eildon GMA	274	548
Katunga WSPA	736	1,472
Mid Goulburn GMA	121	242
Shepparton Irrigation Region GMA	1,131	2,262
Strathbogie GMA	268	536
Upper Goulburn GMA	524	1,048
West Goulburn GMA (1)	1	2
Outside management units	218	436
Total 2017–18	**3,673**	**7,346**
Total 2016–17	3,796	7,592

Note

(1) The management plan for the West Goulburn GMA was approved and published on 28 July 2017.

Groundwater is used to provide urban water supply to Goorambat, Katunga and Strathmerton. The licensed entitlements and metered use for these supplies are presented in Table 7-12. Groundwater use decreased in all towns in 2017–18, compared to 2016–17.

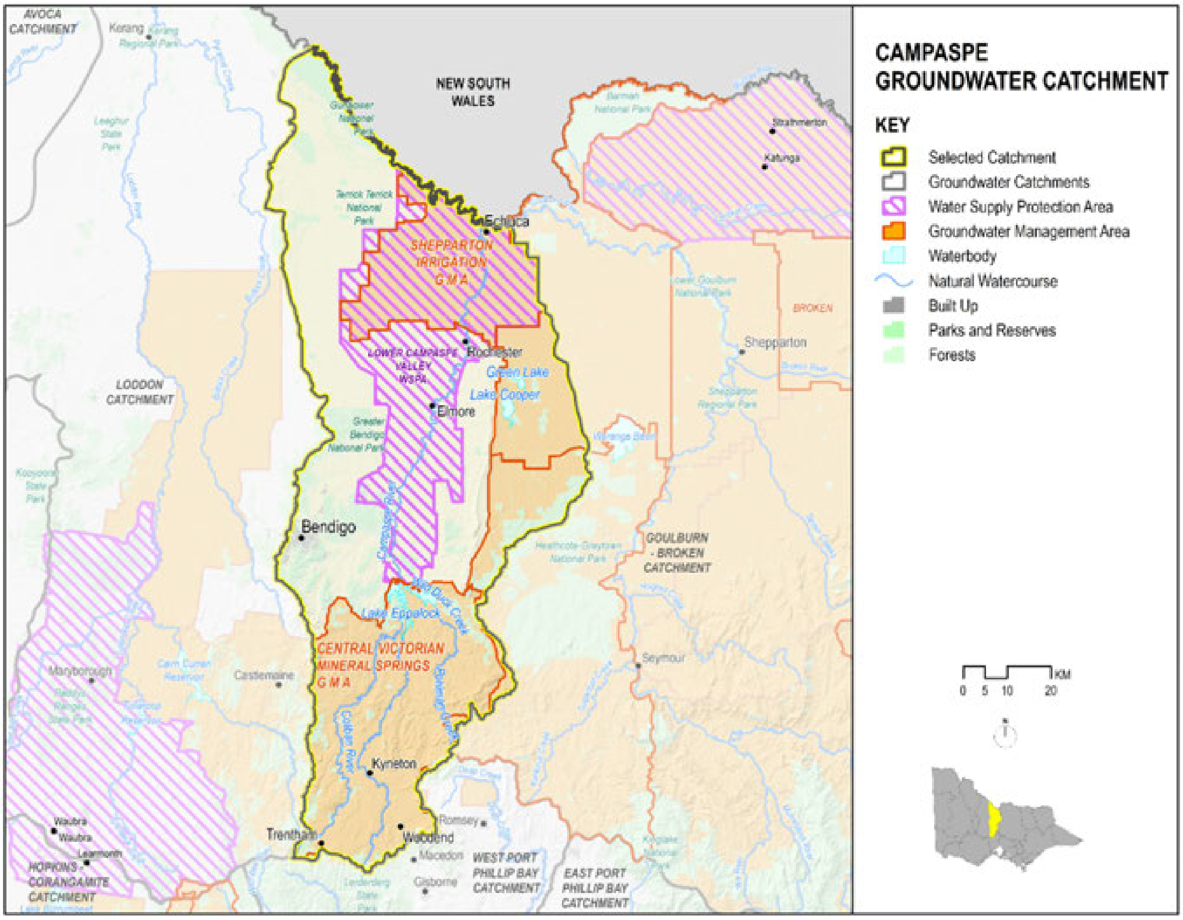
Table 7-12 Urban groundwater volumes and metered use in the Goulburn–Broken groundwater catchment

Town supplied	Licensed volume (ML)	Metered use 2017–18 (ML)	Metered use 2016–17 (ML)
Goorambat	24	10	10
Katunga	110	49	67
Strathmerton	730	0	0
Total	**864**	**59**	**77**

7.2.4 Campaspe groundwater catchment

The Campaspe groundwater catchment is in northern Victoria (Figure 7-5). The catchment extends from the Great Dividing Range at Woodend and Trentham in the south to the Murray River near Echuca in the north.

Figure 7-5 Map of the Campaspe groundwater catchment



7.2.4.1 *Groundwater resources overview*

Groundwater resources in the Campaspe groundwater catchment are managed by Goulburn Murray Water, which is responsible for developing and implementing groundwater management plans. Goulburn Murray Water also issues licences for groundwater use, bore construction and surface water diversions, and it administers domestic and stock use. The Campaspe groundwater catchment is part of the Murray–Darling basin and groundwater management arrangements are subject to the requirements of the Murray–Darling Basin Plan.

The Campaspe groundwater catchment includes the Lower Campaspe Valley WSPA, part of the Shepparton Irrigation Region and West Goulburn GMA (which extend into the Goulburn–Broken catchment) and part of the Central Victorian Mineral Springs GMA (which extends into the Loddon catchment). Groundwater resources supply irrigation, domestic and stock use and the towns of Elmore and Trentham.

A local management plan (approved by Goulburn Murray Water) applies to the Central Mineral Springs GMA and the Shepparton Irrigation Region GMA. The *Lower Campaspe Valley WSPA Management Plan* (approved by the Minister for Water) operates in the Campaspe groundwater catchment. The local management plan for the West Goulburn GMA was approved and published on 28 July 2017.

The groundwater level trends for 2017–18 are presented in Table 7-13. The trends varied from declining to stable across the GMUs within the Campaspe catchment. Although the Lower Campaspe Valley WSPA levels were declining in 2017–18, the Central Victorian Mineral Springs GMA and Shepparton Irrigation Region GMA trends were categorised as stable for much of the year.

Table 7-13 Campaspe groundwater level trends

Groundwater management unit	Groundwater level trend 2017–18				Groundwater level trend June 2017
	Sep-17	Dec-17	Mar-18	Jun-18	
Water supply protection area					
Lower Campaspe Valley	Declining	Declining	Declining	**Declining**	**Declining**
Groundwater management area					
Central Victorian Mineral Springs (1)	Declining	Stable	Stable	**Stable**	**Stable**
Shepparton Irrigation Region (2)	Stable	Stable	Stable	**Stable**	**Rising**
West Goulburn GMA (3)	Stable	Stable	Stable	**Stable**	**Stable**

Notes
(1) The Central Victorian Mineral Springs GMA is partly contained within the Loddon groundwater catchment.
(2) The Shepparton Irrigation Region GMA is partly contained within the Goulburn–Broken groundwater catchment.
(3) The West Goulburn GMA is partly contained within the Goulburn–Broken groundwater catchment.

In 2017–18, 45,854 ML of water was diverted for consumptive purposes — for town, irrigation and commercial supply — which was more than the 25,571 ML diverted in the previous year. Of this volume, 140 ML was diverted for urban use.

An additional 3,438 ML was estimated to have been used for domestic and stock purposes.

7.2.4.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs are shown in Table 7-14. Unlike the previous year, groundwater use was higher in 2017–18, compared to 2016–17.

Table 7-14 Licensed groundwater volumes and use in the Campaspe groundwater catchment

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2017–18	Total licensed groundwater use (ML) 2016–17
Central Victorian Mineral Springs GMA (3)	See note 1	2,275	524	459
Lower Campaspe Valley WSPA	See note 2	55,860	37,432	24,383
Shepparton Irrigation Region GMA (4)	<=25	16,294	6,624	651
Outside management units	-	4,892	1,274	78
Total		**79,321**	**45,854**	**25,571**

Notes
(1) All formations to 200 m below the surface, or 50 m below the base of the basalt or deep lead, whichever is the greater.
(2) All formations below the surface except for all formations from the surface to 25 m below the surface north of the Waranga West Channel.
(3) The Central Victorian Mineral Springs GMA extends into the Loddon groundwater catchment, and an additional 2,739 ML of entitlement volume is reported in the Loddon catchment account (Table 7-18). The total entitlement volume for the Central Victorian Mineral Springs GMA as at 30 June 2018 was 5,014 ML.
(4) The Shepparton Irrigation Region GMA extends into the Goulbourn-Broken groundwater catchment, and an additional 172,152 ML of entitlement volume is reported in the Goulburn–Broken catchment account (Table 7-10). The total entitlement volume for the Shepparton Irrigation Region GMA as at 30 June 2018 was 188,446 ML.

An estimate of domestic and stock groundwater use is shown in Table 7-15. Several groundwater licences also incorporate domestic and stock use and in these cases the use from these bores is reported in the licensed volume in Table 7-14.

Table 7-15 Number of domestic and stock bores and estimated use in the Campaspe groundwater catchment

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 2 ML per bore)
Central Victorian Mineral Springs GMA	800	1,600
Lower Campaspe Valley WSPA	520	1,040
Shepparton Irrigation Region GMA	121	242
Outside management units	278	556
Total 2017–18	**1,719**	**3,438**
Total 2016–17	1,836	3,672

In the Campaspe catchment, groundwater is an option for urban water supply to Elmore and Trentham. Urban groundwater use in the catchment increased in 2017–18, compared to 2016–17. The licensed entitlements and metered use for this supply are shown in Table 7-16.

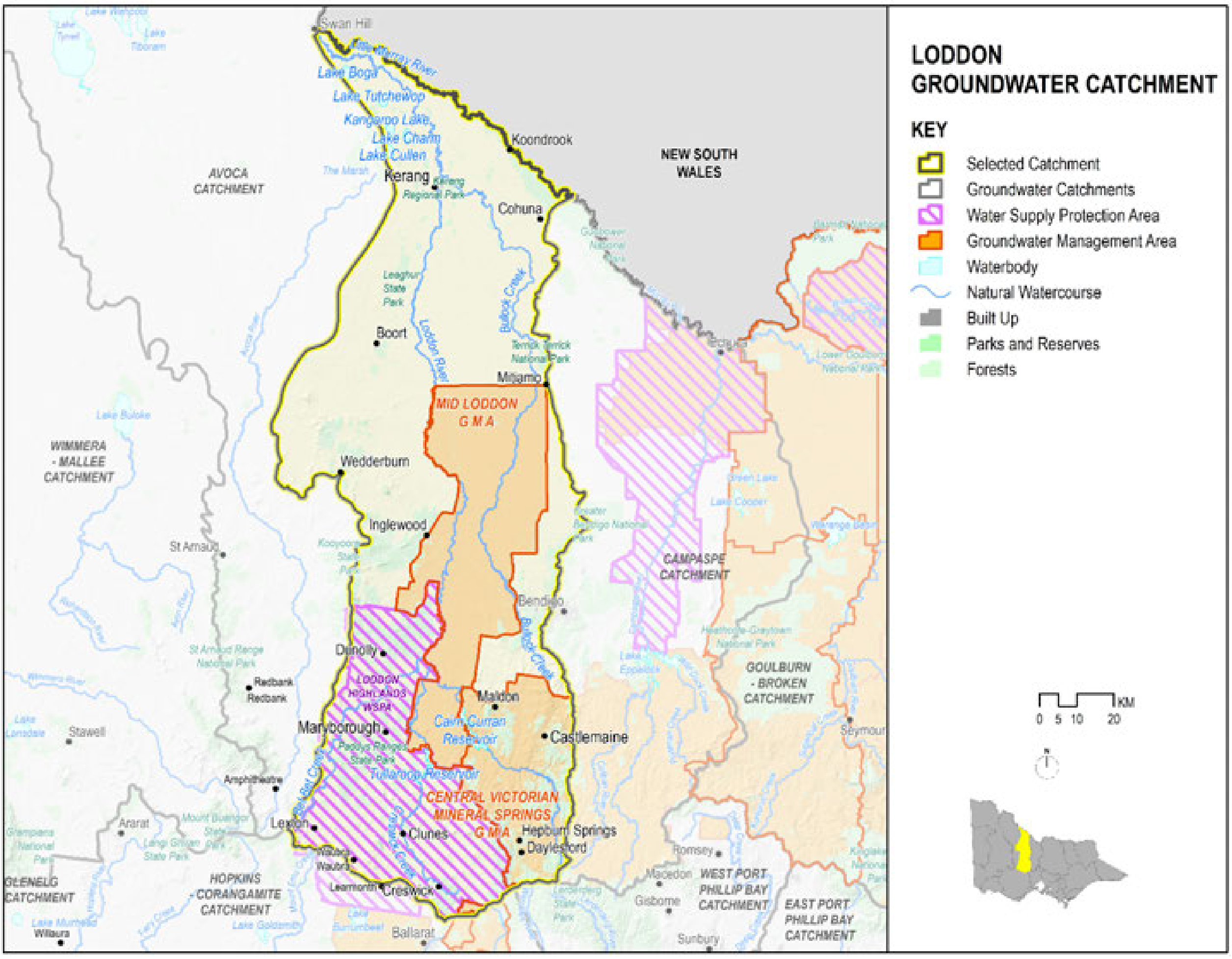
Table 7-16 Urban groundwater use in the Campaspe groundwater catchment

Town supplied	Licensed volume (ML)	Metered use 2017–18 (ML)	Metered use 2016–17 (ML)
Elmore	284	140	96
Trentham	48	0	21
Total	**332**	**140**	**117**

7.2.5 Loddon groundwater catchment

The Loddon groundwater catchment is in northern Victoria (Figure 7-6). The catchment covers an area between Creswick and Swan Hill. Neighbouring groundwater catchments are Avoca to the west, Hopkins–Corangamite and West Port Phillip to the south and Campaspe to the east.

Figure 7-6 Map of the Loddon groundwater catchment



7.2.5.1 *Groundwater resources overview*

Groundwater resources in the Loddon groundwater catchment are managed by Goulburn Murray Water, which is responsible for developing and implementing groundwater management plans. Goulburn Murray Water also issues licences for groundwater use, bore construction and surface water diversions, and it administers domestic and stock use. The Loddon catchment is part of the Murray–Darling basin and groundwater management arrangements are subject to the requirements of the Murray–Darling Basin Plan.

The Loddon groundwater catchment includes all the Mid Loddon GMA, most of Loddon Highlands WSPA (which currently extends into the Hopkins–Corangamite catchment) and part of the Central Victorian Mineral Springs GMA (which currently extends into the Campaspe catchment). Groundwater resources supply licence entitlements, domestic and stock use and six towns in the area.

The groundwater level trends for 2017–18 are presented in Table 7-17. The groundwater level trend was mostly categorised as declining throughout the Loddon groundwater catchment, except for the Central Victorian Mineral Springs GMA which was categorised as stable for most of the year.

Table 7-17 Loddon groundwater level trends

Groundwater management unit	Groundwater level trend 2017–18				Groundwater level trend June 2017
	Sep-17	Dec-17	Mar-18	Jun-18	
Water supply protection area					
Loddon Highlands	Declining	Declining	Declining	**Declining**	Declining
Groundwater management area					
Mid Loddon	Declining	Declining	Declining	**Declining**	**Declining**
Central Victorian Mineral Springs (1)	Declining	Stable	Stable	**Stable**	**Stable**

Note
(1) The Central Victorian Mineral Springs GMA is partly contained within the Campaspe groundwater catchment.

In 2017–18, 32,892 ML of water was diverted for consumptive purposes — for town, irrigation and commercial supply — which was more than the 18,159 ML diverted in the previous year. Of this volume, 809 ML was diverted for urban use.

An additional 2,776 ML was estimated to have been used for domestic and stock purposes.

7.2.5.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs are shown in Table 7-18. In the Loddon groundwater catchment, all management zones in the Loddon Highlands WSPA had an allocation of 100 percent except for the Newlyn Zone, which had an allocation of 75 percent in 2017–18.

Unlike the previous year where use had dropped, in 2017–18 groundwater use in the catchment was higher than the year before.

Table 7-18 Licensed groundwater volumes and use in the Loddon groundwater catchment

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2017–18	Total licensed groundwater use (ML) 2016–17
Central Victorian Mineral Springs GMA (2)	See note 1	2,739	685	423
Loddon Highlands WSPA	All depths	20,502	7,215	5,435
Mid Loddon GMA	All depths	33,877	24,721	12,285
Outside management units	-	5,577	271	16
Total		**62,695**	**32,892**	**18,159**

Notes
(1) All formations to 200 m below the surface, or 50 m below the base of the basalt or deep lead, whichever is the greater.
(2) The Central Victorian Mineral Springs GMA extends into the Campaspe groundwater catchment, and an additional 2,275 ML of entitlement volume is reported in the Campaspe catchment account (Table 7-14). The total entitlement volume for the Central Victorian Mineral Springs GMA as at 30 June 2018 was 5,014 ML.

An estimate of domestic and stock groundwater use is shown in Table 7-19. Several groundwater licences also incorporate domestic and stock use: in these cases, the use from these bores is reported in the licensed volume in Table 7-18.

Table 7-19 Number of domestic and stock bores and estimated use in the Loddon groundwater catchment

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 2 ML per bore)
Central Victorian Mineral Springs GMA	465	930
Loddon Highlands WSPA	487	974
Mid Loddon GMA	328	656
Outside management units	108	216
Total 2017–18	**1,388**	**2,776**
Total 2016–17	1,446	2,892

Groundwater is an urban water supply option for six towns within the catchment. In 2017–18, metered use was higher than in the previous year for all except Daylesford. The licensed entitlements and metered use for urban groundwater supplies in the Loddon groundwater catchment are shown in Table 7-20.

Table 7-20 Urban groundwater volumes and metered use in the Loddon groundwater catchment

Town supplied	Licensed volume (ML)	Metered use 2017–18 (ML)	Metered use 2016–17 (ML)
Clunes	350	221	218
Daylesford	273	4	89
Forest Hill	350	162	132
Learmonth	100	52	48
Maryborough (1)	565	330	126
Waubra	70	40	28
Total	**1,708**	**809**	**641**

Note
(1) The licensed volume for Maryborough excludes a temporary trade of 506 ML.

7.3 Gippsland groundwater region

The Gippsland groundwater region is located in eastern Victoria and contains the East Gippsland, Central Gippsland, Seaspray and Moe groundwater catchments. It is a large sedimentary basin which extends offshore beneath Bass Strait.

The upper aquifers of the Gippsland region occur along the river valleys, floodplains and near the coast. They consist of coarse sand and thick gravel sediments at shallow depths. They also feature the clay aquitard of the Haunted Hill Formation, which overlies most of the sedimentary basin. The upper aquifers occur at or near the ground surface, so they receive recharge directly from rainfall or floods, and they discharge to streams and lakes.

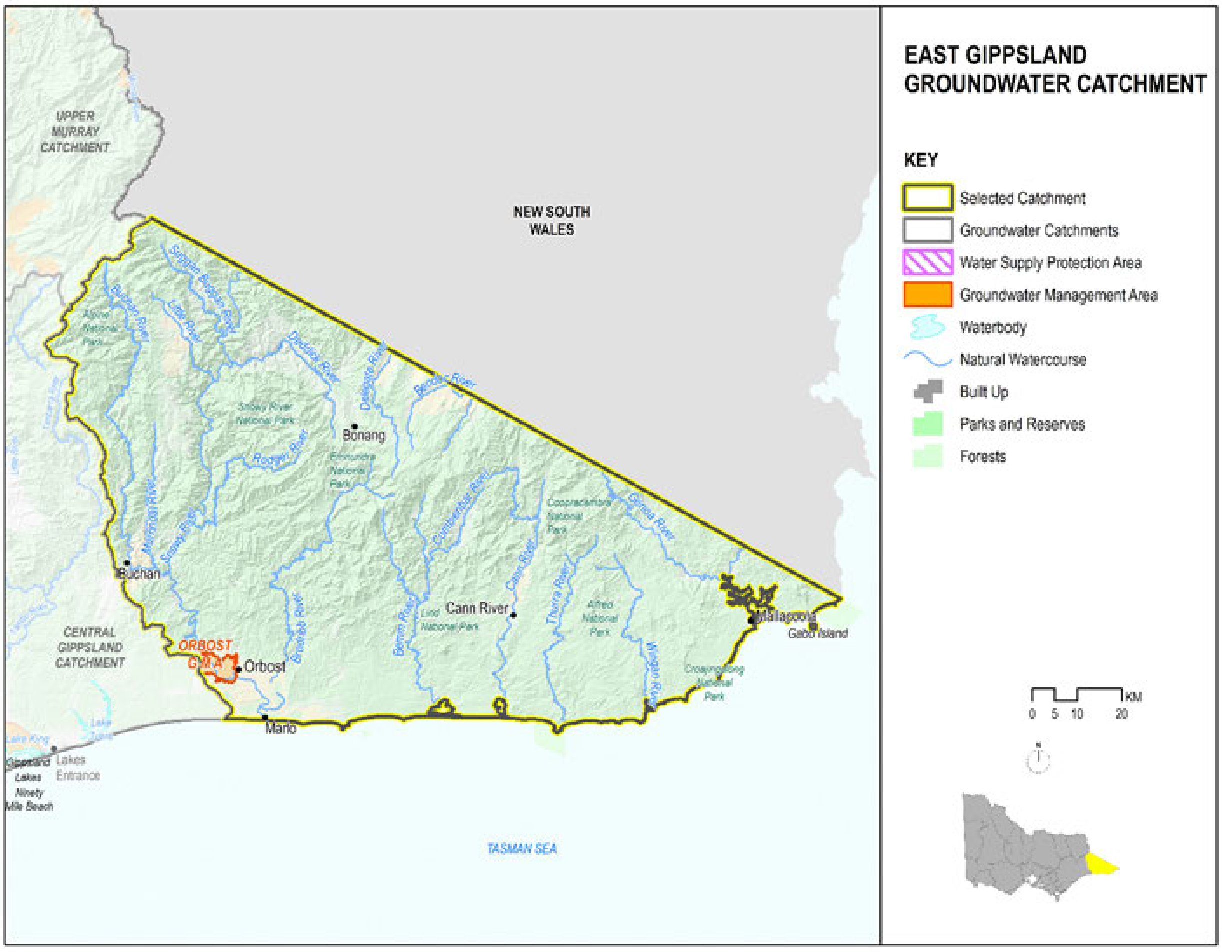
Middle aquifers cover a large part of the Gippsland groundwater region from Moe to Bairnsdale. They comprise thick seams of sand aquifers separated by aquitards. The aquitards are generally clay or coal seams in the north-west of the Gippsland groundwater region, and limestone in the east and centre of the region. Recharge occurs from leakage through the overlying and surrounding sediments, and discharge is to the limestone aquitards to the east of the region and along the coast.

Lower aquifers extend across the Gippsland region and well offshore. They comprise thick sand sediments that rise to the surface in the west and along the basin margin, but are very deep along the coast and offshore. These aquifers are overlain by the upper and middle aquifers together with thick silt, clay, coal and limestone aquitards, and are underlain by bedrock. Where the lower aquifers occur at or near the surface, they receive direct recharge from rainfall and river leakage: in the deeper areas of the basin, recharge occurs by downward leakage. Discharge occurs offshore in Bass Strait.

7.3.1 East Gippsland groundwater catchment

The East Gippsland groundwater catchment (Figure 7-7) is located in the Gippsland region in eastern Victoria. Neighbouring groundwater catchments are Central Gippsland to the west and Upper Murray to the north-west.

Figure 7-7 Map of the East Gippsland groundwater catchment



7.3.1.1 Groundwater resources overview

Groundwater resources in the East Gippsland groundwater catchment are managed by Southern Rural Water, which is responsible for developing and implementing groundwater management plans. Southern Rural Water also issues licences for groundwater use, bore construction and surface water diversions, and it administers domestic and stock use.

The East Gippsland groundwater catchment contains the Orbost GMA. Groundwater supplies irrigation, domestic and stock use and Mallacoota.

The groundwater level trend for 2017–18 is presented in Table 7-21. It was categorised as declining throughout 2017–18.

Table 7-21 East Gippsland groundwater level trend

Groundwater management unit	Groundwater level trend 2017–18				Groundwater level trend June 2017
	Sep-17	Dec-17	Mar-18	Jun-18	
Groundwater management area					
Orbost	Declining	Declining	Declining	**Declining**	**Declining**

In 2017–18, 704 ML of water was diverted for consumptive purposes — for town, irrigation and commercial supply — which was more than the 193 ML diverted in the previous year. Of this volume, 93 ML was diverted for urban use.

An additional 100 ML was estimated to have been used for domestic and stock purposes.

7.3.1.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from the Orbost GMA and UAs are shown in Table 7-22. Groundwater use increased in 2017–18, compared to 2016–17.

Table 7-22 Licensed groundwater volumes and use in the East Gippsland groundwater catchment

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2017–18	Total licensed groundwater use (ML) 2016–17
Orbost GMA	20–45	1,217	537	104
Outside management units	-	888	167	89
Total		**2,105**	**704**	**193**

An estimate of domestic and stock groundwater use is shown in Table 7-23. A number of groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed volume in Table 7-22.

Table 7-23 Number of domestic and stock bores and estimated use in the East Gippsland groundwater catchment

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 1.5 ML per bore) (ML)
Orbost GMA	3	5
Outside management units	63	95
Total 2017–18	**66**	**100**
Total 2016–17	66	100

Within the East Gippsland catchment, groundwater is available for urban water supply to Mallacoota. Urban groundwater use in the East Gippsland groundwater catchment increased slightly in 2017–18, compared to 2016–17. The licensed entitlement and metered use for this supply are shown in Table 7-24.

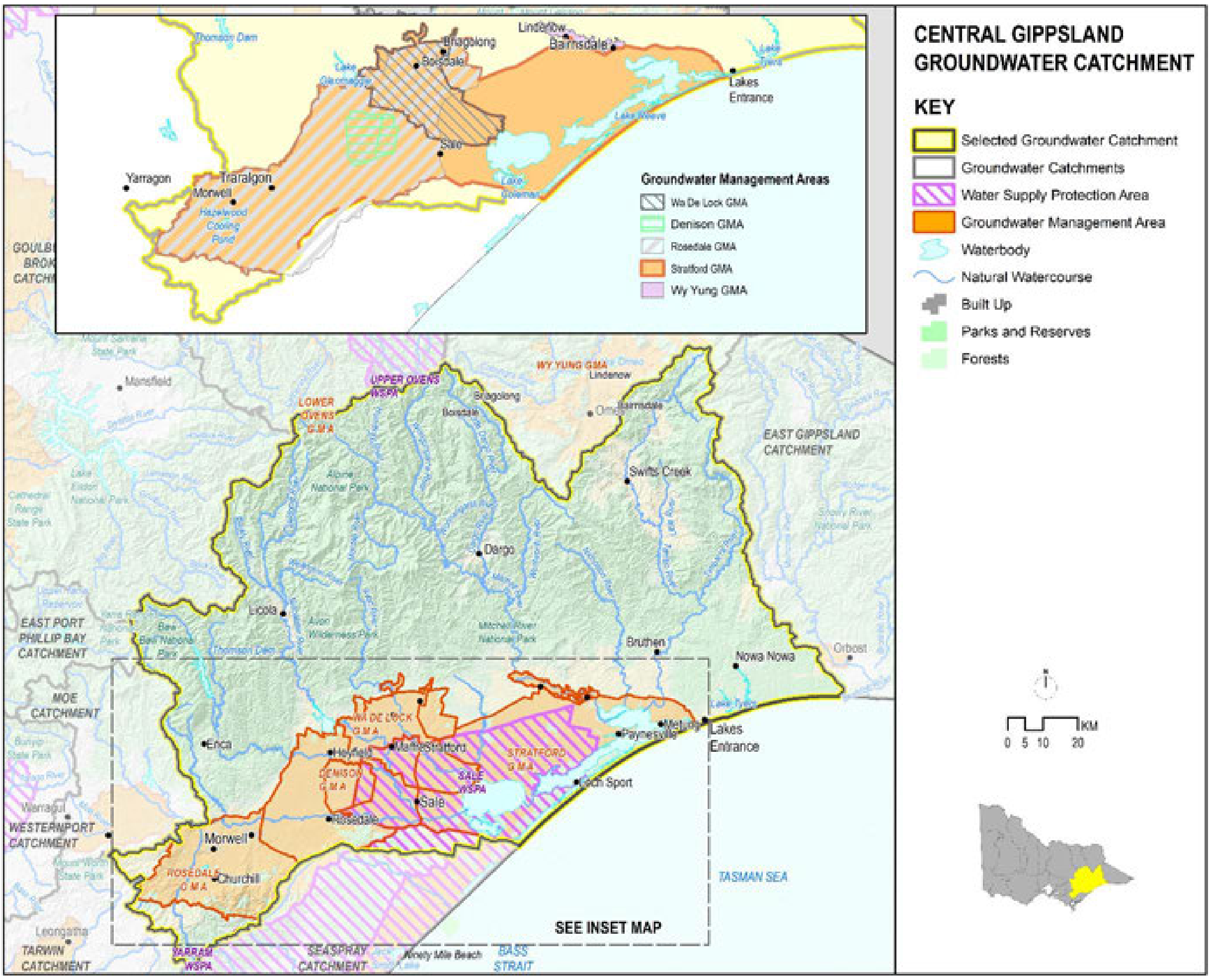
Table 7-24 Urban groundwater volumes and metered use in the East Gippsland groundwater catchment

Town supplied	Licensed volume (ML)	Metered use 2017–18 (ML)	Metered use 2016–17 (ML)
Mallacoota	220	93	80
Total	**220**	**93**	**80**

7.3.2 Central Gippsland groundwater catchment

The Central Gippsland groundwater catchment (Figure 7-8) is located in the Gippsland groundwater region in eastern Victoria and encompasses the major systems of the Gippsland Lakes. Neighbouring groundwater catchments are Goulburn–Broken and Moe to the north-west and west, Ovens and Upper Murray to the north, Tarwin and Seaspray to the south-west and south and East Gippsland to the east.

Figure 7-8 Map of the Central Gippsland groundwater catchment



7.3.2.1 Groundwater resources overview

Groundwater resources in the Central Gippsland groundwater catchment are managed by Southern Rural Water which is responsible for developing and implementing groundwater management plans. Southern Rural Water also issues licences for groundwater use, bore construction and surface water diversions, and it administers domestic and stock use.

The Central Gippsland groundwater catchment contains the Rosedale GMA, Wa De Lock GMA, Denison GMA, Sale WSPA and Wy Yung GMA. It also contains most of the Stratford GMA (which also extends into the Seaspray groundwater catchment), and a small part of both the Moe GMA (the majority of which is in the Moe groundwater catchment) and Yarram WSPA (the majority of which is in the Seaspray groundwater catchment).

Groundwater resources supply licence entitlements, domestic and stock use and also some urban use. While the majority of groundwater use in the Central Gippsland groundwater catchment is for irrigation purposes, groundwater resources also supply four towns in the area as well as the power generators in the Latrobe Valley.

The groundwater level trends for 2017–18 are presented in Table 7-25. The groundwater level trends varied between declining and stable, with most declining in June 2018.

Table 7-25 Central Gippsland groundwater level trends

Groundwater management unit	Groundwater level trend 2017–18				Groundwater level trend June 2017
	Sep-17	Dec-17	Mar-18	Jun-18	
Water supply protection area					
Sale	Declining	Stable	Stable	**Stable**	**Stable**
Yarram (1)	Declining	Declining	Declining	**Declining**	**Declining**
Groundwater management area					
Moe	Declining	Declining	Declining	**Declining**	Declining
Rosedale (2)	Declining	Declining	Declining	**Declining**	**Declining**
Stratford (2)	Declining	Declining	Declining	**Declining**	**Declining**
Wa De Lock	Declining	Declining	Rising	**Declining**	**Stable**
Wy Yung	Declining	Declining	Stable	**Stable**	**Stable**

Notes
(1) Yarram WSPA water levels are influenced by offshore oil and gas extraction.
(2) Rosedale and Stratford GMAs include the dewatering activities from the Loy Yang and Morwell coal mines.

In 2017–18, 71,953 ML of water was diverted for consumptive purposes — for town, irrigation and commercial supply — which was more than the 65,936 ML diverted in the previous year. Of this volume, 2,039 ML was diverted for urban use.

An additional 2,695 ML was estimated to have been used for domestic and stock purposes.

7.3.2.2 Groundwater entitlements and use

Licensed entitlements and use from GMAs are shown in Table 7-26. Groundwater use increased in 2017–18, compared to 2016–17.

Table 7-26 Licensed groundwater volumes and use in the Central Gippsland groundwater catchment

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2017–18	Total licensed groundwater use (ML) 2016–17
Denison GMA (2)	<=25	18,499	8,148	6,882
Moe GMA (3)	>25	33	12	11
Rosedale GMA (1)	Zone 1: 50–150 Zone 2: 25–350 Zone 3: 200–300	22,322	8,844	7,573
Sale WSPA	25–200	21,203	14,447	11,982
Stratford GMA (1) (5)	Zone 1: >150 Zone 2: >350	36,681	22,060	25,089
Wa De Lock GMA (2)	<=25	29,140	8,708	6,984
Wy Yung GMA	<=25	7,462	1,326	560
Yarram WSPA (4)	Zone 1: >200 Zone 2: All depths	6,902	5,019	4,511
Outside management units	-	19,930	3,389	2,344
Total		**162,172**	**71,953**	**65,936**

Notes
(1) The use volume reported in the Rosedale and Stratford GMAs includes metered extractions from Latrobe Valley coal mines (Rosedale GMA 900 ML and Stratford GMA 22,058 ML).
(2) The volumes of use in Denison and Wa De Lock GMAs include metered extractions for salinity control (Denison WSPA 1,003 ML and Wa De Lock GMA 1,130 ML).
(3) The Moe GMA extends into the Moe groundwater catchment, and an additional 3,855 ML of entitlement volume is reported in the Moe catchment account (Table 7-34). The total entitlement volume for the Moe GMA as at 30 June 2018 was 3,888 ML.
(4) The Yarram WSPA extends into the Seaspray groundwater catchment, and an additional 18,672 ML of entitlement volume is reported in the Seaspray catchment account (Table 7-30). The total entitlement volume for the Yarram WSPA as at 30 June 2018 was 25,574 ML.
(5) The Stratford GMA extends into the Seaspray groundwater catchment, and an additional 362 ML of entitlement volume is reported in the Seaspray catchment account (Table 7-30). The total entitlement volume for the Stratford WSPA as at 30 June 2018 was 37,043 ML.

An estimate of domestic and stock groundwater use is shown in Table 7-27. A number of groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed volume in Table 7-26.

Table 7-27 Number of domestic and stock bores and estimated use in the Central Gippsland groundwater catchment

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 1.5 ML per bore) (ML)
Denison GMA	200	300
Rosedale GMA	85	128
Sale WSPA	405	608
Stratford GMA	4	8
Wa De Lock GMA	395	593
Wy Yung WSPA	33	50
Yarram WSPA	82	123
Outside management units	590	885
Total 2017–18	**1,794**	**2,695**
Total 2016–17	1,864	2,800

Note
(1) Estimated domestic and stock use for Stratford GMA is calculated using a factor of 2 ML per bore.

Groundwater is used to provide urban water supply for Boisdale, Briagolong, Lindenow and Sale. The licensed entitlements and metered use for these supplies are presented in Table 7-28.

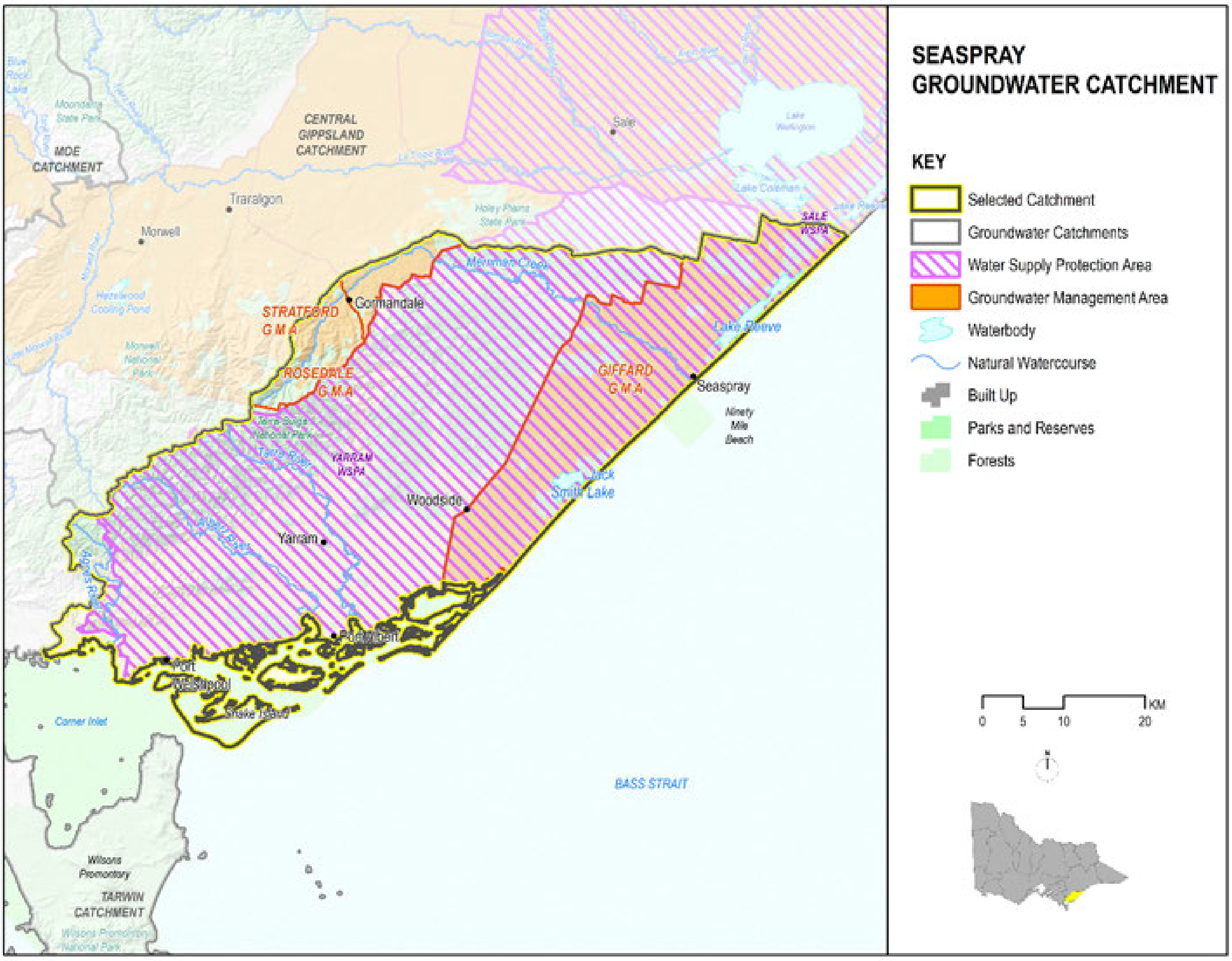
Table 7-28 Urban groundwater volumes and metered use in the Central Gippsland groundwater catchment

Town supplied	Licensed volume (ML)	Metered use 2017–18 (ML)	Metered use 2016–17 (ML)
Boisdale	37	0	37
Briagolong	160	96	79
Lindenow	171	93	0
Sale	3,480	1,850	1,846
Total	**3,848**	**2,039**	**1,962**

7.3.3 Seaspray groundwater catchment

The Seaspray groundwater catchment (Figure 7-9) is located in the Gippsland groundwater region in Victoria's south-east. Neighbouring groundwater catchments are Central Gippsland to the north and Tarwin to the west.

Figure 7-9 Map of the Seaspray groundwater catchment



7.3.3.1 Groundwater resources overview

Groundwater resources in the Seaspray groundwater catchment are managed by Southern Rural Water, which is responsible for developing and implementing groundwater management plans. Southern Rural Water also issues licences for groundwater use, bore construction and surface water diversions, and it administers domestic and stock use.

The catchment contains the Giffard GMA, most of the Yarram WSPA (which also extends into the Central Gippsland catchment) and part of the Stratford GMA. Groundwater resources supply licence entitlements, domestic and stock use and urban water to Yarram. Groundwater use in the Seaspray catchment is predominantly for irrigation.

The groundwater level trends for 2017–18 are presented in Table 7-29. The groundwater level trends were categorised as declining for all GMUs in 2017–18.

Table 7-29 Seaspray groundwater level trends

Groundwater management unit	Groundwater level trend 2017–18				Groundwater level trend June 2017
	Sep-17	Dec-17	Mar-18	Jun-18	
Water supply protection area					
Yarram [(1)]	Declining	Declining	Declining	**Declining**	Declining
Groundwater management area					
Giffard	Declining	Declining	Declining	**Declining**	**Stable**
Stratford [(2)]	Declining	Declining	Declining	**Declining**	**Declining**

Notes

(1) Yarram WSPA water levels are influenced by offshore oil and gas extraction.

(2) Stratford include the dewatering activities from the Loy Yang and Morwell coal mines.

In 2017–18, 13,044 ML of water was diverted for consumptive purposes — for town, irrigation and commercial supply — which was more than the 9,736 ML diverted in the previous year. Of this volume, 42 ML was diverted for urban use.

An additional 499 ML was estimated to have been used for domestic and stock purposes.

7.3.3.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs are shown in Table 7-30. Groundwater use increased in 2017–18, compared to 2016–17.

Table 7-30 Licensed groundwater volumes and use in the Seaspray groundwater catchment

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2017–18	Total licensed groundwater use (ML) 2016–17
Giffard GMA	50–200	5,689	3,784	1,856
Stratford GMA [(2)]	Zone 1: >150 Zone 2: >350	362	17	14
Yarram WSPA [(1)]	Zone 1: >200 Zone 2: All depths	18,672	9,055	7,735
Outside management units	-	1,018	188	131
Total		**25,741**	**13,044**	**9,736**

Notes

(1) The Yarram WSPA extends into the Central Gippsland groundwater catchment, an additional 6,902 ML of entitlement volume is reported in the Central Gippsland catchment account (Table 7-26). The total entitlement volume for the Yarram WSPA as at 30 June 2018 was 25,574 ML.

(2) The Stratford GMA extends into the Central Gippsland groundwater catchment, an additional 36,681 ML of entitlement volume is reported in the Central Gippsland catchment account (Table 7-26). The total entitlement volume for the Stratford WSPA as at 30 June 2018 was 37,043 ML.

An estimate of domestic and stock groundwater use is shown in Table 7-31. A number of groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed volume in Table 7-30.

Table 7-31 Number of domestic and stock bores and estimated use in the Seaspray groundwater catchment

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 1.5 ML per bore) (ML)
Giffard GMA	89	134
Yarram WSPA	176	264
Outside management units	67	101
Total 2017–18	**332**	**499**
Total 2016–17	348	523

Groundwater supplies are available for Yarram. The licensed entitlements and metered use for urban supply are presented in Table 7-32.

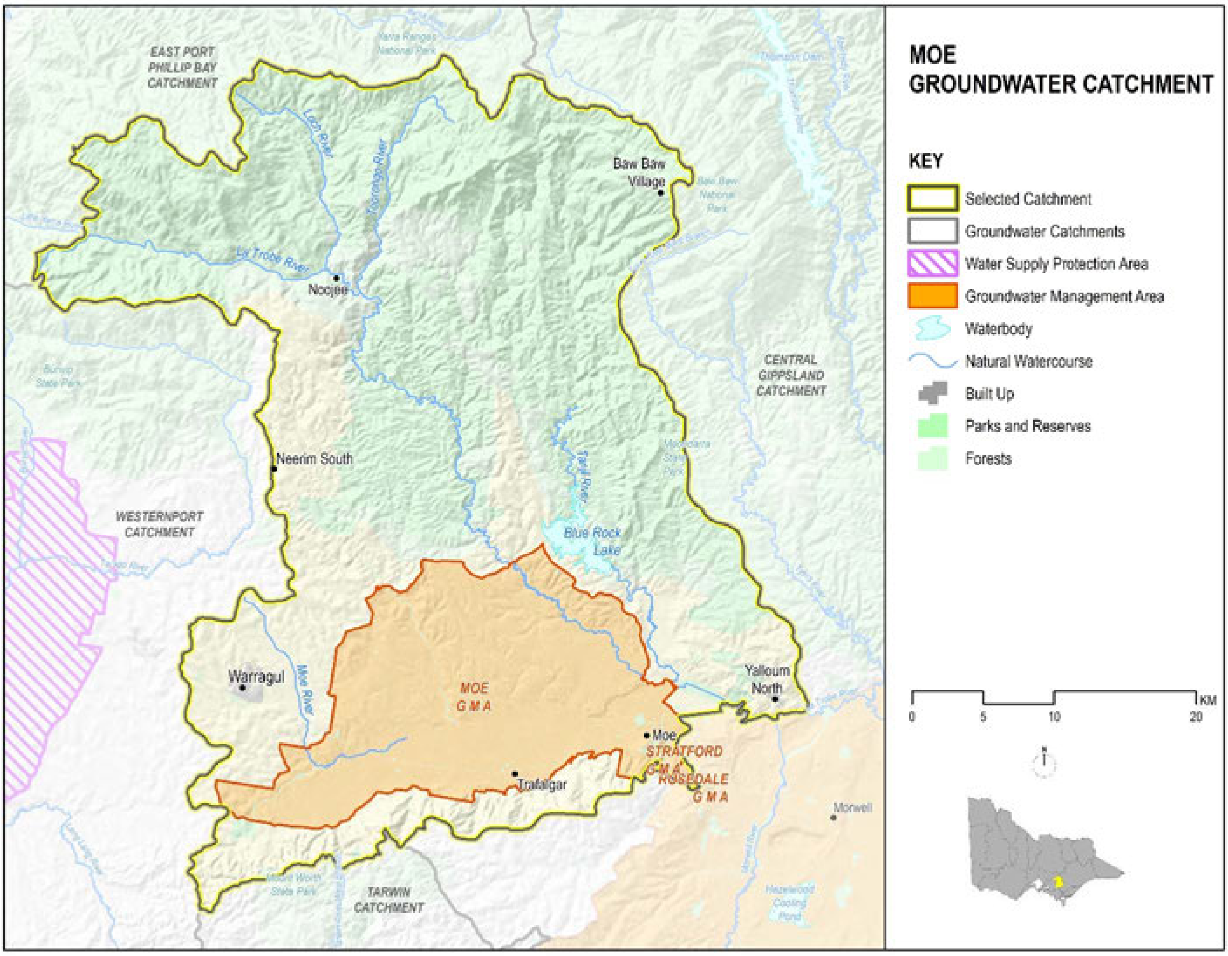
Table 7-32 Urban groundwater volumes and metered use in the Seaspray groundwater catchment

Town supplied	Licensed volume (ML)	Metered use 2017–18 (ML)	Metered use 2016–17 (ML)
Yarram	214	42	0
Total	**214**	**42**	**0**

7.3.4 Moe groundwater catchment

The Moe groundwater catchment (Figure 7-10) is located in the Gippsland groundwater region in eastern Victoria. Neighbouring groundwater catchments are Central Gippsland to the east and south-east, East Port Phillip Bay and Westernport to the west and Tarwin to the south.

Figure 7-10 Map of the Moe groundwater catchment



7.3.4.1 Groundwater resources overview

Groundwater resources in the Moe groundwater catchment are managed by Southern Rural Water, which is responsible for developing and implementing groundwater management plans. Southern Rural Water also issues licences for groundwater use, bore construction and surface water diversions, and it administers domestic and stock use.

The Moe groundwater catchment contains the Moe GMA. Groundwater resources supply licence entitlements, domestic and stock use and Trafalgar. While most groundwater licensed in the Moe GMA is used for irrigation purposes, some is also used for dairy wash-down.

The groundwater level trend for 2017–18 is presented in Table 7-33. The groundwater level trend was categorised as declining throughout the year.

Table 7-33 Moe groundwater level trend

Groundwater management unit	Groundwater level trend 2017–18				Groundwater level trend June 2017
	Sep-17	Dec-17	Mar-18	Jun-18	
Groundwater management area					
Moe	Declining	Declining	Declining	**Declining**	Declining

In 2017–18, 1,313 ML of water was diverted for consumptive purposes — for town, irrigation and commercial supply — which was more than the 1,033 ML diverted in the previous year. There was no urban use in 2017–18.

An additional 299 ML was estimated to have been used for domestic and stock purposes.

7.3.4.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs are shown in Table 7-34. Groundwater use increased in 2017–18, compared to 2016–17.

Table 7-34 Licensed groundwater volumes and use in the Moe groundwater catchment

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2017–18	Total licensed groundwater use (ML) 2016–17
Moe GMA (1)	>25	3,855	893	903
Outside management units	-	1,358	420	130
Total		**5,213**	**1,313**	**1,033**

Note

(1) The Moe GMA extends into the Central Gippsland groundwater catchment, and an additional 33 ML of entitlement volume is reported in the Central Gippsland catchment account (Table 7-26). The total entitlement volume for the Moe GMA as at 30 June 2018 was 3,888 ML.

An estimate of domestic and stock groundwater use is shown in Table 7-35. A number of groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed volume in Table 7-34.

Table 7-35 Number of domestic and stock bores and estimated use in the Moe groundwater catchment

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 1.5 ML per bore) (ML)
Moe GMA	109	164
Outside management units	90	135
Total 2017–18	**199**	**299**
Total 2016–17	210	315

Groundwater supplies are available for Yarragon. The licensed entitlements and metered use for urban supply are shown in Table 7-36.

Table 7-36 Urban groundwater volumes and metered use in the Moe groundwater catchment

Town supplied	Licensed volume (ML)	Metered use 2017–18 (ML)	Metered use 2016–17 (ML)
Yarragon	100	0	0
Total	**100**	**0**	**0**

7.4 Central groundwater region

The Central groundwater region comprise the Port Phillip, Westernport and Tarwin groundwater regions, which are grouped for management purposes. These basins are located in south-central Victoria and encompass area around Port Phillip Bay and extending into South Gippsland. Groundwater catchments in the Central groundwater region are Tarwin, Westernport, East Port Phillip Bay and West Port Phillip Bay.

The upper aquifers of the Central groundwater region occur along the river valleys, near the coast and on the plains west of Melbourne. Sand and gravel aquifers underlie productive farmland along the river valleys and floodplains of Bacchus Marsh, Werribee and near Yarra Glen. Near Koo Wee Rup, the upper aquifer is mostly formed of clay and generally acts as an aquitard except in the south-eastern area where it occurs at the surface. Recharge to the upper aquifers occurs directly from rainfall and discharge is to streams and the bays.

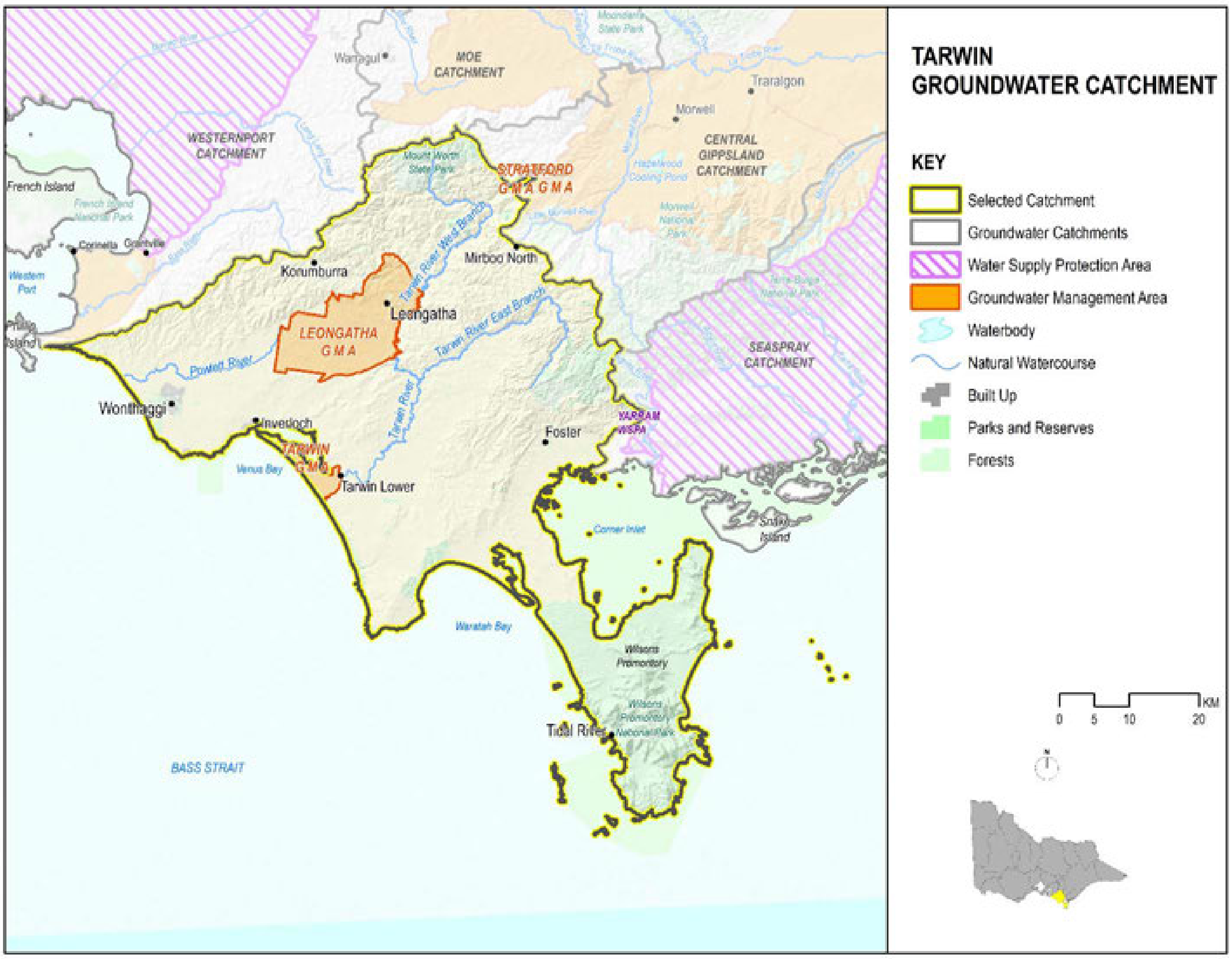
The middle aquifers of the Central groundwater region cover a large part of the area. They are made up of several formations, which are connected and act as one aquifer in each region. These aquifers vary in composition and include fine sands, coarse sand and gravel, clay and limestone. These aquifers are partially underlain by the middle aquitard, which mainly consists of coal and silt. The middle aquifers are mostly buried and confined by the upper aquifer: however, they are at the surface and unconfined on the eastern side of Port Phillip Bay. Recharge occurs from leakage through the overlying sediments or from direct rainfall recharge where the aquifers are near the surface.

Lower aquifers extend across the region. They lie very deep along the coast or in some areas at or close to the surface. The aquifers comprise largely sand, sandstone and basalt, and some also contain clay and coal layers that act as aquitards. The bedrock is buried by the lower aquifers where they are deepest along the coast, but it reaches the surface in the highlands, where it forms the Great Dividing Range, Mornington Peninsula Highlands and Strzelecki Ranges. In the ranges, the bedrock acts as a low-yielding fractured rock aquifer and, where it is buried, it acts as an aquitard. Direct rainfall recharge occurs where the aquifers and bedrock are at the surface; elsewhere, recharge occurs as leakage.

7.4.1 Tarwin groundwater catchment

The Tarwin groundwater catchment is located in south-east Victoria (Figure 7-11). Neighbouring groundwater catchments are Westernport to the west, Central Gippsland and Seaspray to the east and Moe to the north. Bass Strait forms the catchment's southern boundary.

Figure 7-11 Map of the Tarwin groundwater catchment



7.4.1.1 *Groundwater resources overview*

Groundwater resources in the Tarwin groundwater catchment are managed by Southern Rural Water, which is responsible for developing and implementing groundwater management plans. Southern Rural Water also issues licences for groundwater use, bore construction and surface water diversions, and it administers domestic and stock use.

The Tarwin groundwater catchment contains the Leongatha GMA and Tarwin GMA. Groundwater resources supply licence entitlements, domestic and stock use and Leongatha.

The groundwater level trends for 2017–18 are shown in Table 7-37. The groundwater level trends were mostly stable during the year.

Table 7-37 Tarwin groundwater level trends in the Tarwin groundwater catchment

Groundwater management unit	Groundwater level trend 2017–18				Groundwater level trend June 2017
	Sep-17	Dec-17	Mar-18	Jun-18	
Groundwater management area					
Leongatha	Declining	Stable	Stable	**Stable**	**Declining**
Tarwin	Stable	Stable	Stable	**Stable**	**Stable**

In 2017–18, 239 ML of water was diverted for consumptive purposes — for town, irrigation and commercial supply — which was more than the 159 ML diverted in the previous year. Of this volume, 7 ML was diverted for urban use.

An additional 1,115 ML was estimated to have been used for domestic and stock purposes.

7.4.1.2 *Groundwater entitlements and use*

Licensed groundwater entitlements and use from GMUs are shown in Table 7-38. There was slightly more groundwater use in 2017–18, compared to 2016–17.

Table 7-38 Licensed groundwater volumes and use in the Tarwin groundwater catchment

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2017–18	Total licensed groundwater use (ML) 2016–17
Leongatha GMA	All depths	1,803	170	115
Tarwin GMA	<=25	58	15	5
Outside management units	-	344	54	39
Total		**2,205**	**239**	**159**

An estimate of domestic and stock groundwater use is shown in Table 7-39. A number of groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed volume in Table 7-38.

Table 7-39 Number of domestic and stock bores and estimated use in the Tarwin groundwater catchment

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 1.5 ML per bore) (ML)
Leongatha GMA	71	107
Tarwin GMA	432	648
Outside management units	240	360
Total 2017–18	**743**	**1,115**
Total 2016–17	818	1,228

Groundwater supply is available for Leongatha. The licensed entitlement and metered use for urban supply are shown in Table 7-40.

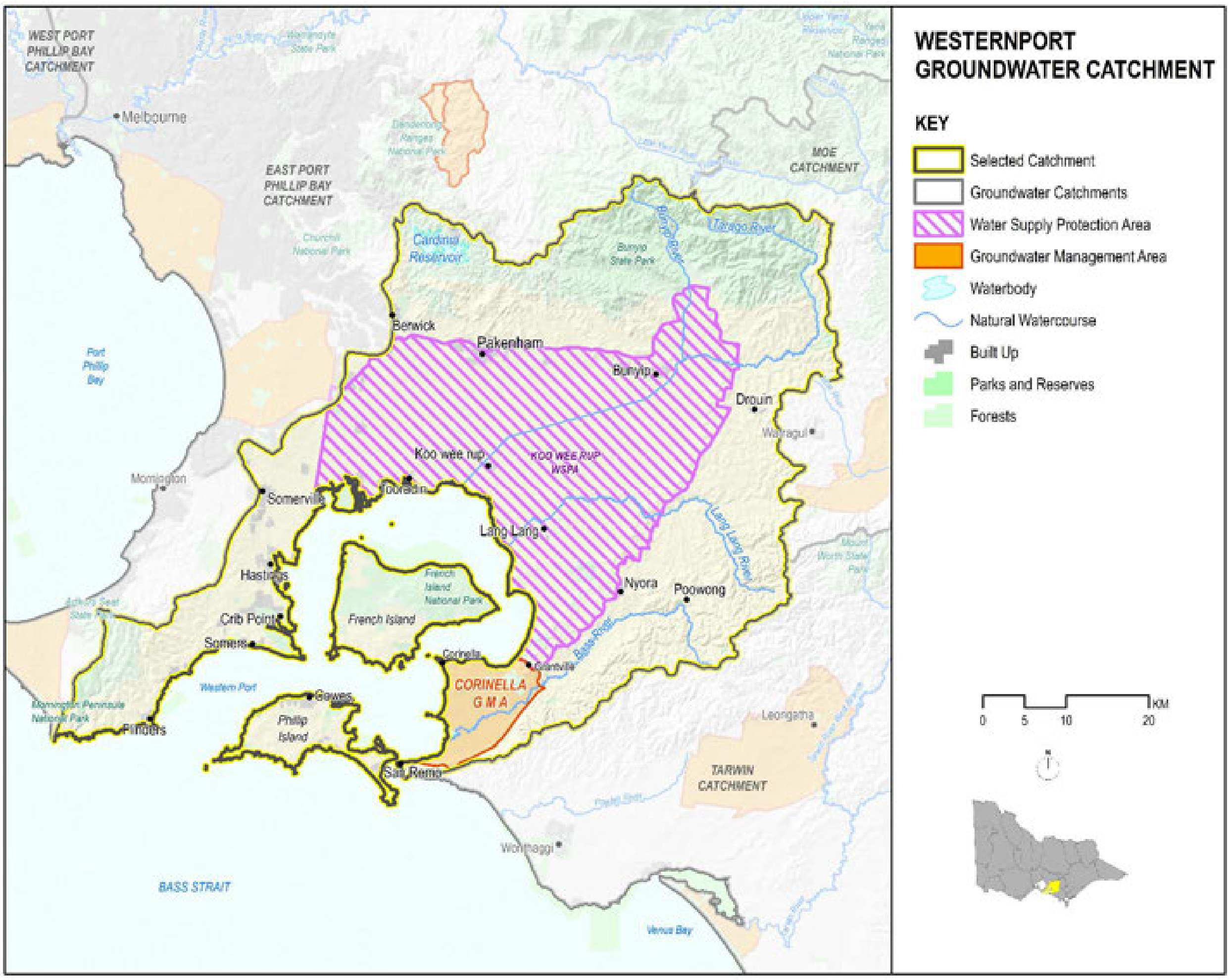
Table 7-40 Urban groundwater volumes and metered use in the Tarwin groundwater catchment

Town supplied	Licensed volume (ML)	Metered use 2017–18 (ML)	Metered use 2016–17 (ML)
Leongatha	715	7	0
Total	**715**	**7**	**0**

7.4.2 Westernport groundwater catchment

The Westernport groundwater catchment is located in southern Victoria (Figure 7-12). Neighbouring groundwater catchments are East Port Phillip Bay to the west, Moe to the north-east and Tarwin to the south-east.

Figure 7-12 Map of the Westernport groundwater catchment



7.4.2.1 Groundwater resources overview

Groundwater resources in the Westernport groundwater catchment are managed by Southern Rural Water, which is responsible for developing and implementing groundwater management plans. Southern Rural Water also issues licences for groundwater use, bore construction and surface water diversions, and it administers domestic and stock use.

The Westernport groundwater catchment contains the Corinella GMA and most of the Koo Wee Rup WSPA (which extends into the East Port Phillip Bay groundwater catchment). Groundwater resources supply licence entitlements, domestic and stock use and the towns of Corinella, Grantville and Lang Lang.

The groundwater level trends for 2017–18 are shown in Table 7-41. The groundwater level trends were categorised as declining throughout the groundwater catchment.

Table 7-41 Westernport groundwater level trends

Groundwater management unit	Groundwater level trend 2017–18				Groundwater level trend June 2017
	Sep-17	Dec-17	Mar-18	Jun-18	
Water supply protection area					
Koo Wee Rup	Declining	Declining	Declining	**Declining**	**Stable**
Groundwater management area					
Corinella	Declining	Declining	Declining	**Declining**	**Stable**

In 2017–18, 4,236 ML of water was diverted for consumptive purposes — for town, irrigation and commercial supply — which was more than the 4,076 ML diverted in the previous year. There was no urban use in 2017–18.

An additional 2,067 ML was estimated to have been used for domestic and stock purposes.

7.4.2.2 Groundwater entitlements and use

Licensed entitlements and use from GMUs are shown in Table 7-42. Groundwater use increased in 2017–18, compared to 2016–17.

Table 7-42 Licensed groundwater volumes and use in the Westernport groundwater catchment

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2017–18	Total licensed groundwater use (ML) 2016–17
Corinella GMA	All depths	662	56	66
Koo Wee Rup WSPA [(1)]	All depths	12,544	3,458	3,503
Outside management units	-	4,467	722	507
Total		**17,673**	**4,236**	**4,076**

Note

(1) The Koo Wee Rup WSPA extends into the East Port Phillip Bay groundwater catchment, and an additional 111 ML of entitlement volume is reported in the East Port Phillip Bay catchment account (Table 7-46). The total entitlement volume for the Koo Wee Rup WSPA as at 30 June 2018 was 12,655 ML.

An estimate of domestic and stock groundwater use is shown in Table 7-43. A number of groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed volume in Table 7-42.

Table 7-43 Number of domestic and stock bores and estimated use in the Westernport groundwater catchment

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 1.5 ML per bore) (ML)
Corinella GMA	57	86
Koo Wee Rup WSPA	911	1,367
Outside management units	409	614
Total 2017–18	**1,377**	**2,067**
Total 2016–17	1,443	2,165

Groundwater is available as an urban water supply to Corinella and Grantville as well as Lang Lang. There was no metered use of groundwater for urban supply in 2017–18 (Table 7-44).

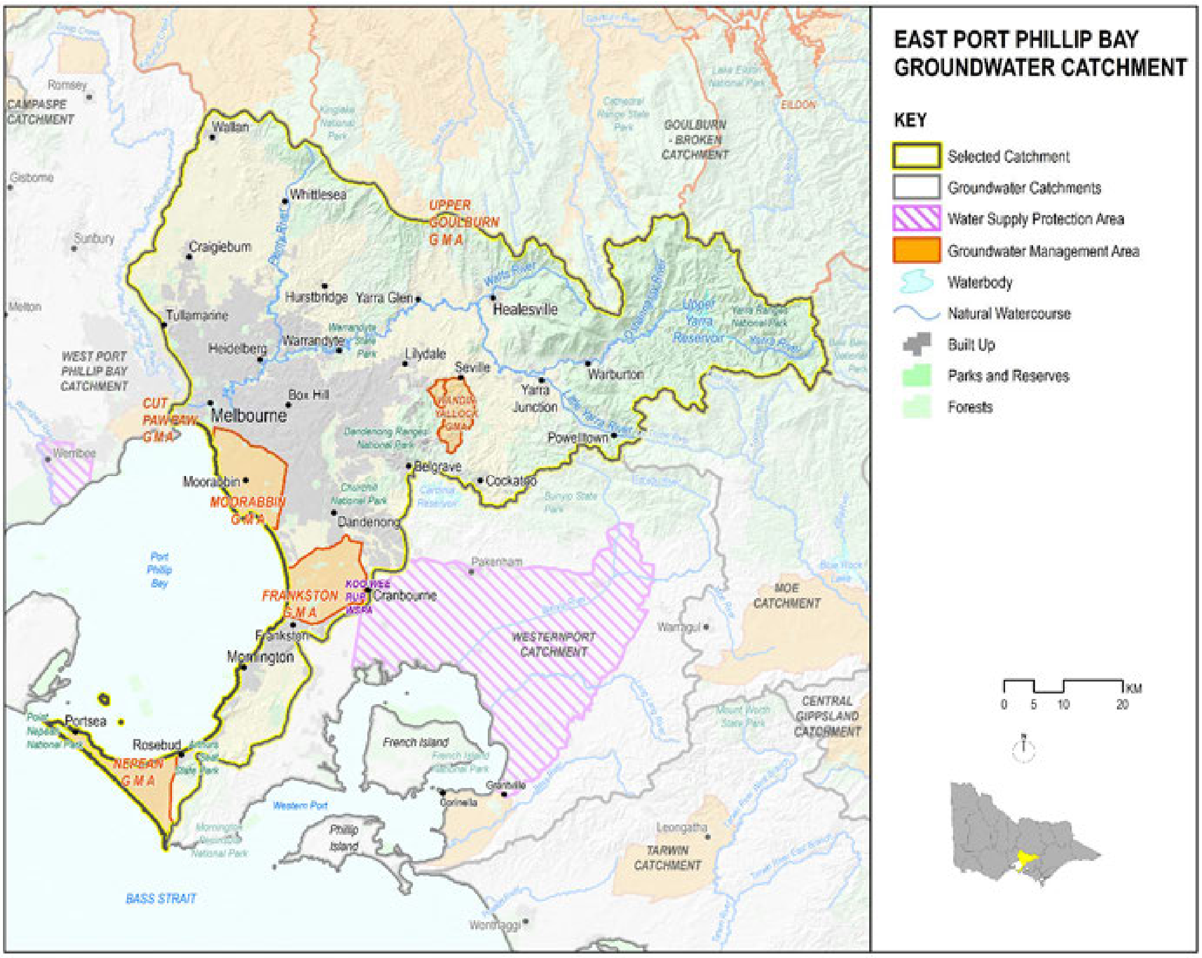
Table 7-44 Urban groundwater volumes and metered use in the Westernport groundwater catchment

Town supplied	Licensed volume (ML)	Metered use 2017–18 (ML)	Metered use 2016–17 (ML)
Corinella / Grantville	490	0	0
Lang Lang	119	0	0
Total	**609**	**0**	**0**

7.4.3 East Port Phillip Bay groundwater catchment

The East Port Phillip Bay groundwater catchment is located in southern Victoria (Figure 7-13). Neighbouring groundwater catchments are West Port Phillip Bay to the west, Goulburn–Broken to the north and Westernport and Moe to the east.

Figure 7-13 Map of the East Port Phillip Bay groundwater catchment



7.4.3.1 *Groundwater resources overview*

Groundwater resources in the East Port Phillip Bay groundwater catchment are managed by Southern Rural Water, which is responsible for developing and implementing groundwater management plans. Southern Rural Water also issues licences for groundwater use, bore construction and surface water diversions, and it administers domestic and stock use.

The East Port Phillip Bay groundwater catchment contains the Frankston GMA, Moorabbin GMA, Nepean GMA, a small part of Koo Wee Rup WSPA (which is mainly within the Westernport groundwater catchment) and the Wandin Yallock GMA.

Groundwater resources supply licence entitlements, and domestic and stock use. Groundwater in the East Port Phillip Bay groundwater catchment is mainly used for irrigation, with some bores licensed for industrial and commercial purposes. Groundwater resources are not used for urban supply in the East Port Phillip Bay groundwater catchment.

The groundwater level trends for 2017–18 are shown in Table 7-45. The groundwater level trends varied across the groundwater catchment during the year between rising and declining. Three GMUs ended the year with a stable trend, and the Frankston GMA and Koo Wee Rup WSPA ending the year with a declining trend.

Table 7-45 East Port Phillip Bay groundwater level trends

Groundwater management unit	Groundwater level trend 2017–18				Groundwater level trend June 2017
	Sep-17	Dec-17	Mar-18	Jun-18	
Water supply protection area					
Koo Wee Rup	Declining	Declining	Declining	**Declining**	**Stable**
Groundwater management area					
Frankston	Stable	Stable	Stable	**Declining**	**Stable**
Moorabbin	Declining	Rising	Rising	**Stable**	**Declining**
Nepean	Stable	Stable	Stable	**Stable**	**Stable**
Wandin Yallock	Declining	Declining	Declining	**Stable**	**Declining**

In 2017–18, 6,569 ML of water was diverted for consumptive purposes (irrigation and commercial supply). This was more than the 5,748 ML diverted in the previous year. There are no urban use licences in the East Port Phillip Bay groundwater catchment.

An additional 3,755 ML was estimated to have been used for domestic and stock purposes.

7.4.3.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs are shown in Table 7-46. Groundwater use increased in 2017–18, compared to 2016–17.

Table 7-46 Licensed groundwater volumes and use in the East Port Phillip Bay groundwater catchment

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2017–18	Total licensed groundwater use (ML) 2016–17
Frankston GMA	All depths	2,195	119	148
Koo Wee Rup WSPA (1)	All depths	111	0	0
Moorabbin GMA	All depths	2,581	1,212	925
Nepean GMA	See note 2	6,110	3,024	2,304
Wandin Yallock GMA	All depths	3,006	664	564
Outside management units	-	12,919	1,550	1,807
Total		**26,922**	**6,569**	**5,748**

Notes

(1) The Koo Wee Rup WSPA extends into the Westernport groundwater catchment, and an additional 12,544 ML of entitlement volume is reported in the Westernport catchment account (Table 7-42). The total entitlement volume for the Koo Wee Rup WSPA as at 30 June 2018 was 12,655 ML.

(2) The Upper Aquifer, being all aquifers from the natural surface to 200 m below the natural surface, or the natural surface to 50 m below the base of the Quaternary Aquifer, Upper Tertiary Fluvial Aquifer or the Lower Tertiary Basalts, whichever is the deeper.

An estimate of domestic and stock groundwater use is shown in Table 7-47. A number of groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed volume in Table 7-46.

Table 7-47 Number of domestic and stock bores and estimated use in the East Port Phillip Bay groundwater catchment

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 1.5 ML per bore) (ML)
Frankston GMA	81	122
Moorabbin GMA	188	282
Nepean GMA (1)	1,734	1,734
Wandin Yallock GMA	48	72
Outside management units	1,030	1,545
Total 2017–18	**3,081**	**3,755**
Total 2016–17	3,253	3,970

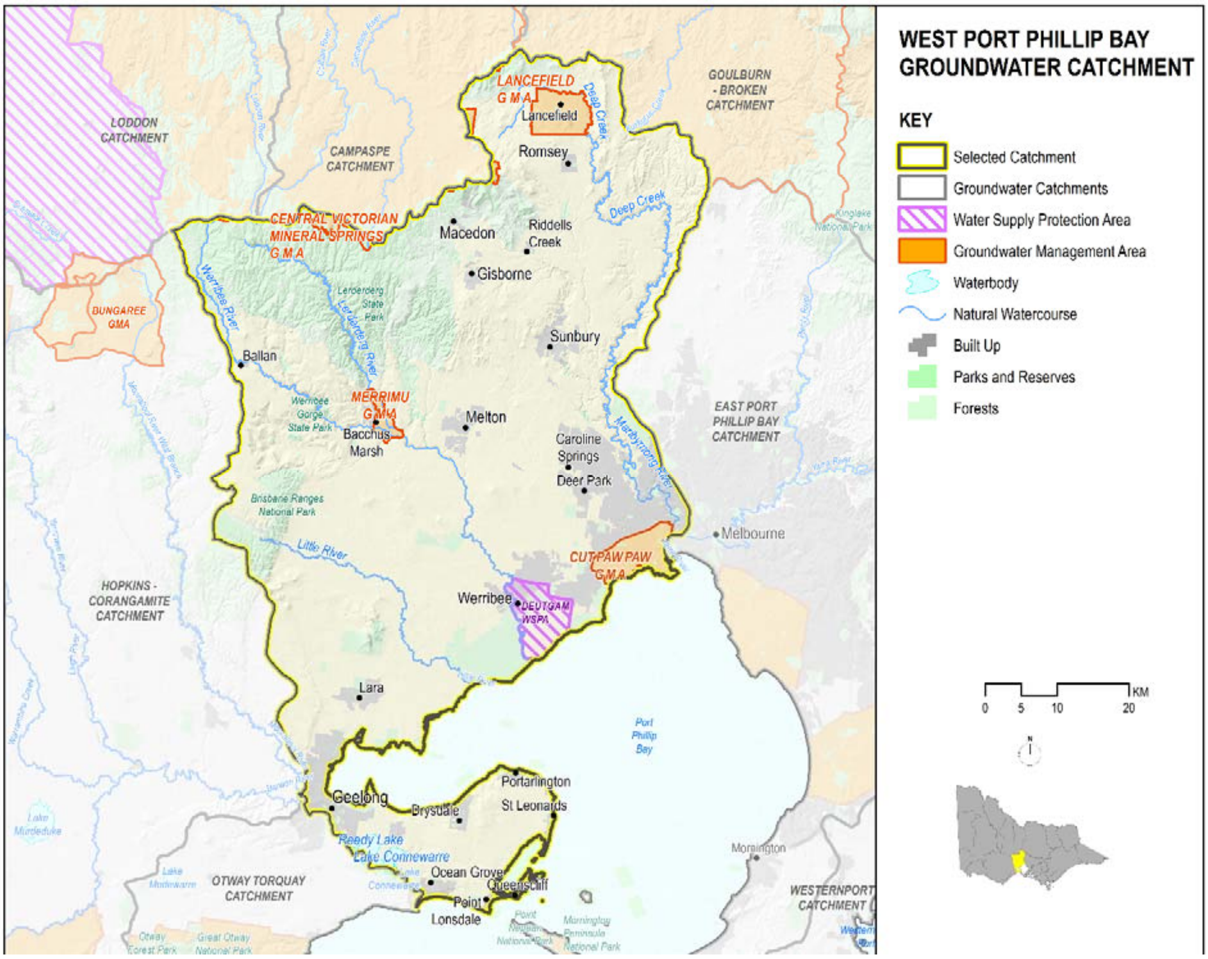
Note

(1) Estimated stock and domestic use in Nepean GMA is calculated using a factor 1 ML per bore.

7.4.4 West Port Phillip Bay groundwater catchment

The West Port Phillip Bay groundwater catchment is located in southern Victoria (Figure 7-14). Neighbouring groundwater catchments are Hopkins–Corangamite to the west; Loddon, Campaspe and Goulburn–Broken to the north; and East Port Phillip Bay to the east.

Figure 7-14 Map of the West Port Phillip Bay groundwater catchment



7.4.4.1 Groundwater resources overview

Groundwater resources in the West Port Phillip Bay groundwater catchment are managed by Southern Rural Water, which is responsible for developing and implementing groundwater management plans. Southern Rural Water also issues licences for groundwater use, bore construction and surface water diversions, and it administers domestic and stock use.

The catchment contains the Cut Paw Paw GMA, Lancefield GMA, Merrimu GMA and Deutgam WSPA. A very small portion of the Central Victorian Mineral Springs GMA is also contained in the very north of the West Port Phillip Bay groundwater catchment, but the majority is contained within the Campaspe and Loddon groundwater catchments. Groundwater resources supply licence entitlements and domestic and stock use in the area and are also available to supply Blackwood, Lancefield and Romsey.

In the West Port Phillip Bay groundwater catchment, the Deutgam WSPA opening allocation for the 2017–18 irrigation season from 1 July 2017 was 50 percent. This allocation was increased on 19 December 2017 to 100 percent for the remainder of the season.

The groundwater level trends for 2017–18 are shown in Table 7-48. Groundwater level trends were categorised between declining and rising. The Deutgam WSPA was categorised as declining in June with the two GMAs ending the year with a stable trend. Observation bores were not available to determine a trend in the Cut Paw Paw GMA.

Table 7-48 West Port Phillip Bay groundwater level trends

Groundwater management unit	Groundwater level trend 2017–18				Groundwater level trend June 2017
	Sep-17	Dec-17	Mar-18	Jun-18	
Water supply protection area					
Deutgam	Declining	Declining	Declining	**Declining**	Declining
Groundwater management area					
Lancefield	Rising	Rising	Rising	**Stable**	**Stable**
Merrimu	Declining	Declining	Declining	**Stable**	**Declining**

In 2017–18, 2,680 ML of water was diverted for consumptive purposes — for town, irrigation and commercial supply — which was more than the 2,474 ML diverted in the previous year. Of this volume, 62 ML was diverted for urban use.

An additional 1,851 ML was estimated to have been used for domestic and stock purposes.

7.4.4.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs are shown in Table 7-49. Groundwater use increased in 2017–18, compared to 2016–17. Deutgam WSPA received a seasonal allocation of 50 percent at the beginning of 2017–18. This increased to 100 percent in December 2017.

Table 7-49 Licensed groundwater volumes and use in the West Port Phillip Bay groundwater catchment

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2017–18	Total licensed groundwater use (ML) 2016–17
Cut Paw Paw GMA	>50	514	18	26
Deutgam WSPA	<=30	5,082	912	527
Lancefield GMA	All depths	1,378	339	193
Outside management units	-	10,823	1,411	1,728
Total		**17,797**	**2,680**	**2,474**

An estimate of domestic and stock groundwater use is shown in Table 7-50. Use of domestic and stock bores across the West Port Phillip Bay groundwater catchment decreased in 2017–18, compared to 2016–17.

Table 7-50 Number of domestic and stock bores and estimated use in the West Port Phillip Bay groundwater catchment

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 1.5 ML per bore) (ML)
Cut Paw Paw GMA	4	6
Deutgam WSPA	37	56
Lancefield GMA	48	72
Merrimu GMA	11	17
Outside management units	1,133	1,700
Total 2017–18	**1,233**	**1,851**
Total 2016–17	1,292	1,939

Within the West Port Phillip Bay groundwater catchment, groundwater is an urban water supply option for Blackwood, Lancefield and Romsey. As shown in Table 7-51, urban groundwater use increased in 2017–18.

Table 7-51 Urban groundwater volumes and metered use in the West Port Phillip Bay groundwater catchment

Town supplied	Licensed volume (ML)	Metered use 2017–18 (ML)	Metered use 2016–17 (ML)
Blackwood	50	0	1
Lancefield	294	7	13
Romsey	600	55	0
Total	**944**	**62**	**14**

7.5 Otway–Torquay groundwater region

The Otway–Torquay groundwater region is located in south-western Victoria and extends offshore along the southern margin of Victoria and South Australia to the north-west of Tasmania. It borders the Goulburn–Murray groundwater region and the Wimmera–Mallee groundwater region to the north and the Central region to the east.

The upper aquifers of the Otway–Torquay groundwater region are found extensively across the south-west of the region and include volcanic aquifers, a significant sand and limestone aquifer and some older sand aquifers. The unconfined volcanic aquifers stretch from Ballarat to Portland and consist of scoria and fractured basalt. They are thickest near Ballarat, Colac, Portland and south of Hamilton. The unconfined sand and limestone aquifer occurs along the South Australian border. In the places where these aquifers are at the ground surface, they can receive recharge directly from rainfall. Discharge is mainly by leakage from the upper aquifer to the middle aquifer and also occurs through baseflows to streams. The upper aquifers interact closely with surface water (such as rivers, creeks, drainage lines, wetlands, swamps and lakes).

Middle aquifers occur across the southern part of the region, stretching from the South Australian border near the Grampians across to Port Campbell. There are two main levels of middle aquifers — known as the upper middle aquifers and lower middle aquifers — which are separated by a thick aquitard of impermeable silts and clays. The upper middle aquifer largely comprises Port Campbell limestone and is located close to the surface. It is semi-confined by the upper aquifer and receives recharge mainly from rainfall. It sometimes acts as one unit with the overlying sand and limestone aquifer.

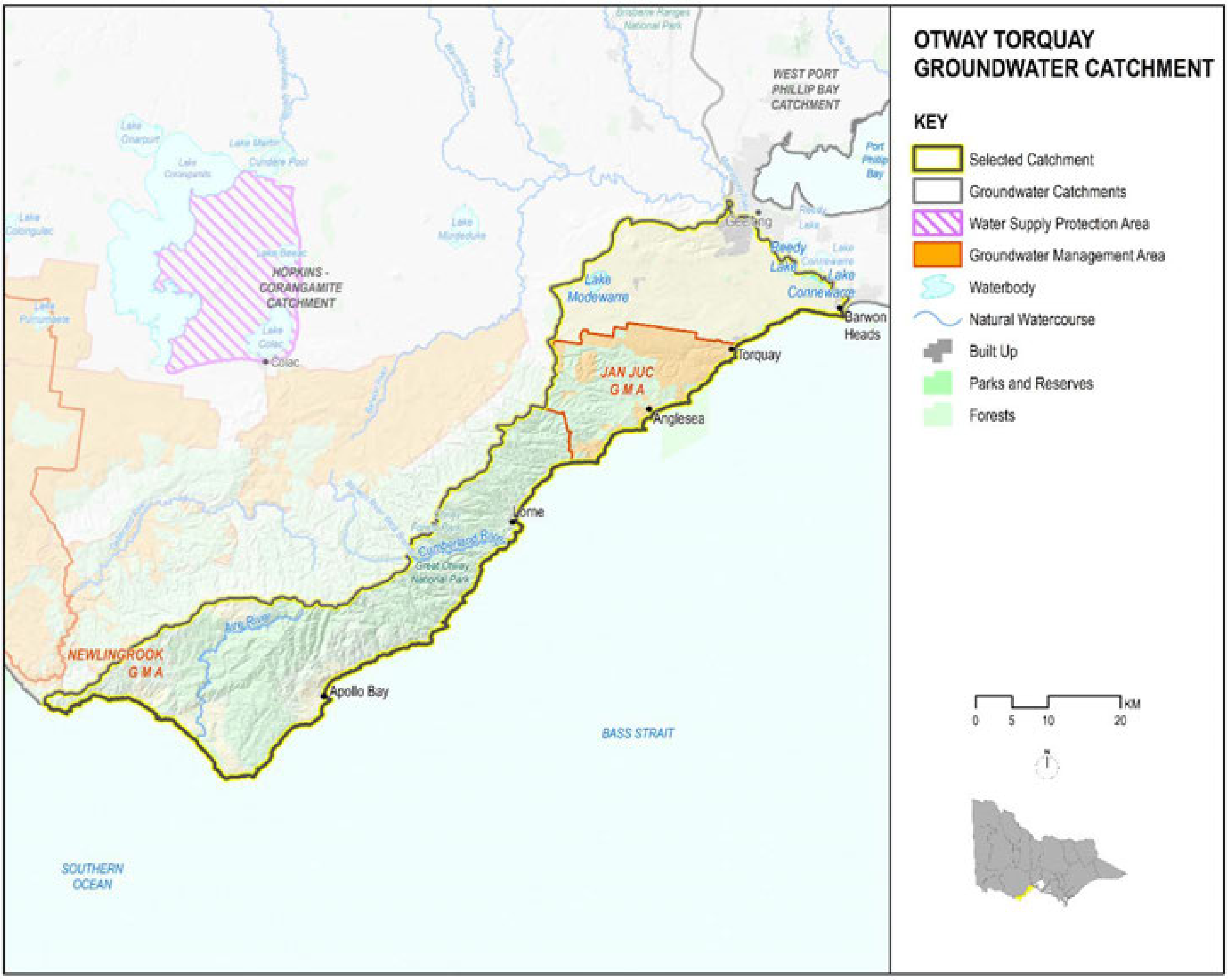
Most of the lower middle aquifer is confined by overlying layers and below by thick marl aquitards; the exception is the region along its northern reaches where it connects to the lower aquifers. The lower middle aquifer relies on upward and downward leakage from adjacent formations for recharge. Discharge for both the upper middle and lower middle aquifers is most likely to occur along the coastline or into other formations. There is also some surface discharge to swamps and leakage in low-lying areas.

The lower aquifers occur across the south of the region, stretching from the South Australian border south of the Grampians across to Port Phillip Bay. In many parts of the region, they are overlain by hundreds of metres of sediment, but in the region's north and around the Otway Ranges they occur at or near the surface as unconfined aquifers. The lower aquifers mainly comprise alternating layers of sand and clay, but some are sand aquifers with minor amounts of silt and brown coal. Near the coast, the aquifers are under pressure and groundwater from these aquifers can reach temperatures of 50–60° C. The lower aquifers are underlain by bedrock comprised mainly of siltstone, which reaches the surface around the region margin to form the Grampians, the Otway Ranges and the Central Highlands.

7.5.1 Otway–Torquay groundwater catchment

The Otway–Torquay groundwater catchment (Figure 7-15) is located in the Otway–Torquay groundwater region in south-west Victoria. Much of the catchment boundary is along the coastline. Neighbouring groundwater catchments are Hopkins–Corangamite to the north-west and West Port Phillip Bay to the north-east.

Figure 7-15 Map of the Otway–Torquay groundwater catchment



7.5.1.1 Groundwater resources overview

Groundwater resources in the Otway–Torquay groundwater catchment are managed by Southern Rural Water which is responsible for developing and implementing groundwater management plans. Southern Rural Water also issues licences for groundwater use, bore construction and surface water diversions, and it administers domestic and stock use.

The Otway–Torquay catchment contains the Jan Juc GMA. Groundwater resources supply licence entitlements and domestic and stock use and Geelong.

The groundwater level trend for 2017–18 is shown in Table 7-52. The groundwater level trend for Jan Juc GMA was categorised as stable at the beginning of the year, rose in March and then declined towards the end of 2017–18.

Table 7-52 Otway–Torquay groundwater level trends

Groundwater management unit	Groundwater level trend 2017–18				Groundwater level trend June 2017
	Sep-17	Dec-17	Mar-18	Jun-18	
Groundwater management area					
Jan Juc	Stable	Stable	Rising	**Declining**	**Stable**

In 2017–18, 11 ML of water was diverted for consumptive purposes (irrigation and commercial supply). This was less than the 224 ML diverted in the previous year. There was no urban use in 2017–18.

An additional 46 ML was estimated to have been used for domestic and stock purposes.

7.5.1.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs are shown in Table 7-53. Groundwater use for 2017–18 decreased significantly, compared to 2016–17.

Table 7-53 Licensed groundwater volumes and use in the Otway–Torquay groundwater catchment

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2017–18	Total licensed groundwater use (ML) 2016–17
Jan Juc GMA	All depths	14,250	7	223
Outside management units	All depths	95	4	1
Total		**14,345**	**11**	**224**

An estimate of domestic and stock groundwater use is shown in Table 7-54. A number of groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed volume in Table 7-53.

Table 7-54 Number of domestic and stock bores and estimated use in the Otway–Torquay groundwater catchment

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 1.5 ML per bore) (ML)
Jan Juc GMA	3	5
Outside management units	27	41
Total 2017–18	**30**	**46**
Total 2016–17	30	46

In the Otway–Torquay groundwater catchment, groundwater is used for urban water supply for greater Geelong. The licensed entitlement and metered use for these groundwater supplies are shown in Table 7-55.

The first groundwater bulk entitlement was granted to Barwon Water on 1 July 2009. The *Bulk Entitlement (Anglesea Groundwater) Order 2009* allows Barwon Water to extract a maximum of 10,000 ML of groundwater in any given year, but it cannot exceed an average 7,000 ML per year in any five-year period. The bulk entitlement supplements supply to homes and businesses in greater Geelong, Anglesea, Torquay and Lorne. No groundwater was extracted under this bulk entitlement in 2017–18.

Barwon Water also holds a groundwater licence for the Barwon Downs borefield, located near Colac in the Hopkins–Corangamite groundwater catchment for urban water supply in greater Geelong. This use is reported for that catchment in Table 7-59.

Table 7-55 Urban groundwater volumes and metered use in the Otway–Torquay groundwater catchment

Town supplied	Licensed volume (ML)	Metered use 2017–18 (ML)	Metered use 2016–17 (ML)
Greater Geelong (Anglesea Bore Field)	10,000	0	0
Total	**10,000**	**0**	**0**

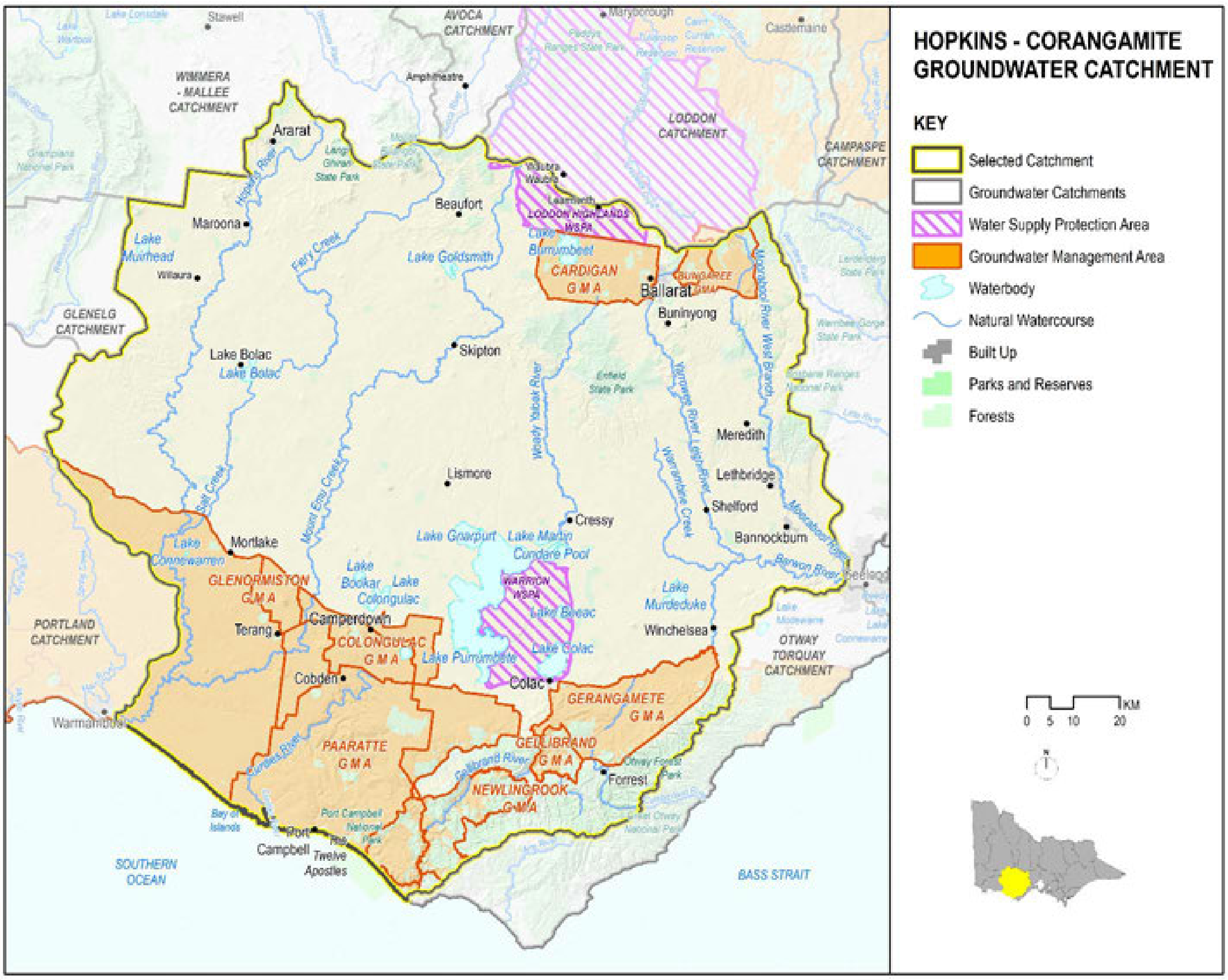
Note

(1) Use over the last seven years was 4,019 ML in 2011–12 and zero each year since.

7.5.2 Hopkins–Corangamite groundwater catchment

The Hopkins–Corangamite groundwater catchment (Figure 7-16) is located in the Otway–Torquay groundwater region in south-western Victoria. Neighbouring groundwater catchments are Portland and Glenelg to the west; Wimmera–Mallee, Avoca and Loddon to the north; West Port Phillip Bay to the east; and Otway–Torquay to the south-east.

Figure 7-16 Map of the Hopkins–Corangamite groundwater catchment



7.5.2.1 Groundwater resources overview

Groundwater resources in the Hopkins–Corangamite groundwater catchment are managed by Southern Rural Water, which is responsible for developing and implementing groundwater management plans. Southern Rural Water also issues licences for groundwater use, bore construction and surface water diversions, and it administers domestic and stock use.

The Hopkins–Corangamite groundwater catchment contains the Cardigan GMA, Colongulac GMA, Gellibrand GMA, Gerangamete GMA, Glenormiston GMA, Newlingrook GMA, Paaratte GMA and Warrion WSPA. Bungaree GMA (which had its WSPA status revoked by the Minister for Water in December 2016) is also located in this groundwater catchment. The South West Limestone GMA is partly within the Hopkins–Corangamite groundwater catchment. It also contains a small part of the Loddon Highlands WSPA, most of which is in the Loddon groundwater catchment.

Groundwater resources in the Hopkins–Corangamite groundwater catchment are mainly used for urban supply and irrigation.

The groundwater level trends for 2017–18 are shown in Table 7-56. The groundwater level trends were generally categorised as stable for the majority of the year. The Warrion WSPA had a rising trend for the whole year and the Bungaree and South West Limestone GMAs ended the year with a declining trend.

Table 7-56 Hopkins–Corangamite groundwater level trends

Groundwater management unit	Groundwater level trend 2017–18				Groundwater level trend June 2017
	Sep-17	Dec-17	Mar-18	Jun-18	
Water supply protection area					
Warrion	Rising	Rising	Rising	**Rising**	**Stable**
Groundwater management area					
Bungaree	Declining	Stable	Declining	**Declining**	**Stable**
Cardigan	Stable	Stable	Declining	**Stable**	**Declining**
Colongulac	Stable	Rising	Rising	**Rising**	**Rising**
Gellibrand	Stable	Stable	Stable	**Stable**	**Stable**
Gerangamete (1)	Stable	Rising	Stable	**Stable**	**Declining**
Newlingrook	Stable	Stable	Stable	**Stable**	**Stable**
Paaratte	Stable	Stable	Stable	**Stable**	**Stable**
South West Limestone (2)	Stable	Stable	Stable	**Declining**	**Stable**

Notes

(1) There are insufficient state observation bores in the Glenormiston GMA to adequately define the groundwater resource or changes to the resource over time.

(2) The South West Limestone GMA is partly contained within the Hopkins–Corangamite, Portland and Glenelg groundwater catchments.

In 2017–18, 31,377 ML of water was diverted for consumptive purposes — for town, irrigation and commercial supply — which was more than the 26,954 ML diverted in the previous year. Of this volume, 941 ML was diverted for urban use.

An additional 4,156 ML was estimated to have been used for domestic and stock purposes.

7.5.2.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs are shown in Table 7-57. Groundwater use in 2017–18 was more than the previous year.

Table 7-57 Licensed groundwater volumes and use in the Hopkins–Corangamite groundwater catchment

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2017–18	Total licensed groundwater use (ML) 2016–17
Bungaree GMA (1)	All depths	5,293	2,967	2,291
Cardigan GMA	All depths	3,899	742	751
Colongulac GMA	<=60 m	4,406	1,287	1,244
Gerangamete GMA (2)	>60	20,000	3	1,546
Glenormiston GMA	<=60	2,636	1,382	1,078
Newlingrook GMA	All depths	1,958	47	89
Paaratte GMA (3)	Variable depths (3)	3,212	334	314
South West Limestone GMA, Hopkins–Corangamite (4) (5)	See note 4	27,411	16,697	11,749
Warrion WSPA	All depths	14,079	3,466	3,702
Outside management units	-	12,254	4,452	4,190
Total		**95,148**	**31,377**	**26,954**

Notes

(1) The licensed entitlement volume for Bungaree GMA includes a 55 ML mineral water licence.

(2) This entitlement is held by Barwon Water and has the following limits: 20,000 ML in one year, 80,000 ML over 10 years and 400,000 ML over 100 years. The entitlement limit in Table 7-57 represents the single-year limit, but compliance is also assessed at the 10-year and 100-year levels.

(3) The Paaratte GMA PCV was amended on 23 April 2018. 4,606 ML or 4,606 plus an additional volume that may be taken under a section 51 licence for the take and use of groundwater for pumping tests or the Managed Aquifer Recharge scheme. Licensed entitlements must not exceed 4,692 ML. The amended order stipulated variable depths to the GMA using contour lines to define the upper and lower boundaries of the GMA.

(4) The South West Limestone GMA depth range is from the top of the upper mid-tertiary limestone down to 50 m below the top of the underlying upper mid-tertiary aquitard, except where the aquitard is thin or absent, in which case the depth limit is the base of the aquitard or the base of the limestone.

(5) The South West Limestone GMA extends into both the Portland and Glenelg groundwater catchments, and an additional 37,924 ML and 16,242 ML of entitlement volume is reported in the Portland and Glenelg catchment accounts respectively (Table 7-61 and Table 7-65). The total entitlement volume for the South West Limestone GMA as at 30 June 2018 was 54,166 ML.

An estimate of domestic and stock groundwater use is shown in Table 7-58. A number of groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed use in Table 7-57.

Table 7-58 Number of domestic and stock bores and estimated use in the Hopkins–Corangamite groundwater catchment

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 1.5 ML per bore) (ML)
Bungaree GMA	159	239
Cardigan GMA	79	119
Colongulac GMA	95	143
Gerangamete GMA	5	8
Glenormiston GMA	65	98
Loddon Highlands WSPA (1)	85	170
Newlingrook GMA	2	3
Paaratte GMA	2	3
South West Limestone GMA	1,241	1,862
Warrion WSPA	237	356
Outside management units	770	1,155
Total 2017–18	**2,740**	**4,156**
Total 2016–17	2,813	4,265

Note
(1) Estimated domestic and stock use for Loddon Highlands WSPA is calculated using a factor of 2 ML per bore.

In the Hopkins–Corangamite groundwater catchment, groundwater provides urban water supply to Beaufort, Caramut, Darlington, Dean, Mortlake, Port Campbell, Timboon, Peterborough, Curdie Vale, Streatham, areas around Carlisle, Ballarat and Geelong. Licensed entitlements and metered use for urban supply are shown in Table 7-59. Total metered use decreased in 2017–18, compared to 2016–17.

Barwon Water also holds a bulk entitlement for the Anglesea groundwater borefield (located in the Otway–Torquay groundwater catchment) to provide urban water supply in greater Geelong, including Anglesea, Torquay and Lorne. This use is reported for that catchment in Table 7-55.

Grampians Wimmera Mallee Water provide urban groundwater supply to Willaura. Although Willaura is located in the Hopkins–Corangamite groundwater catchment, the bores that supply the town are located in Mafeking in the Wimmera–Mallee groundwater catchment and are therefore reported in that chapter (see chapter 7.6.2).

Table 7-59 Urban groundwater volumes and metered use in the Hopkins–Corangamite groundwater catchment

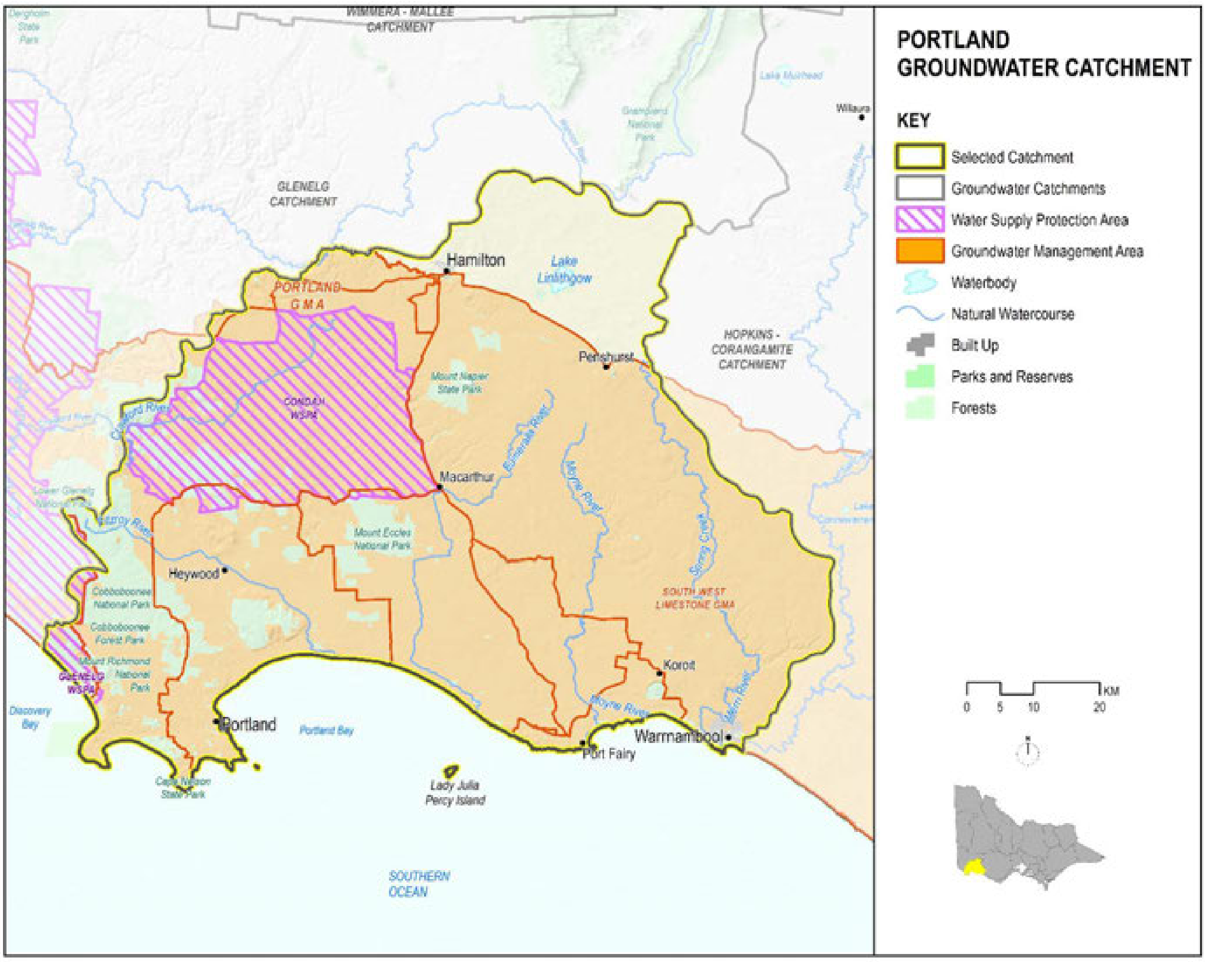
Town supplied	Licensed volume (ML)	Metered use 2017–18 (ML)	Metered use 2016–17 (ML)
Ballarat - Bungaree Bore	69	3	9
Ballarat West (1)	3,000	423	532
Beaufort	200	40	0
Caramut	50	25	31
Darlington	10	4	3
Dean	30	16	15
Greater Geelong (Barwon Downs borefield) (2)	20,000	3	1,546
Mortlake (part)	335	27	11
Otway system (Carlisle)	1,800	33	36
Port Campbell, Timboon, Peterborough & Curdie Vale	3,159	334	320
Streatham	60	33	25
Total	**28,713**	**941**	**2,528**

Notes
(1) The volume of the licence for Ballarat is 1,700 ML, but up to 3,000 ML may be taken in any one year during a water shortage.
(2) Barwon Water holds a groundwater licence issued by Southern Rural Water which allows Barwon Water to extract 20,000 ML in one year, 80,000 ML over 10 years and 400,000 ML over 100 years from the Barwon Downs borefield to supply greater Geelong.

7.5.3 Portland groundwater catchment

The Portland groundwater catchment (Figure 7-17) is located in the Otway–Torquay groundwater region in south-western Victoria. Neighbouring groundwater catchments are Glenelg to the west and Hopkins–Corangamite to the east.

Figure 7-17 Map of the Portland groundwater catchment



7.5.3.1 Groundwater resources overview

Groundwater resources in the Portland groundwater catchment are managed by Southern Rural Water, which is responsible for developing and implementing groundwater management plans. Southern Rural Water also issues licences for groundwater use, bore construction and surface water diversions, and it administers domestic and stock use.

The Portland groundwater catchment contains the Condah WSPA, Portland GMA, a portion of the South West Limestone GMA and part of the Glenelg WSPA. Groundwater resources supply licence entitlements, domestic and stock use and 12 towns in the area. Most groundwater use in the Portland groundwater catchment is for irrigation and urban use and to a lesser extent for dairy wash and industrial supply.

The groundwater level trends for 2017–18 are shown in Table 7-60. The groundwater level trends were categorised as declining in the Portland GMA for the year, and they were mostly stable in the South West Limestone GMA and Condah WSPA.

Table 7-60 Portland groundwater level trends

Groundwater management unit	Groundwater level trend 2017–18				Groundwater level trend June 2017
	Sep-17	Dec-17	Mar-18	Jun-18	
Water supply protection area					
Condah	Declining	Stable	Stable	**Stable**	**Stable**
Groundwater management area					
Portland	Declining	Declining	Declining	**Declining**	**Declining**
South West Limestone (1)	Stable	Stable	Stable	**Declining**	**Stable**

Note
(1) The South West Limestone GMA is partly contained within the Hopkins–Corangamite, Portland and Glenelg groundwater catchments.

In 2017–18, 20,008 ML of water was diverted for consumptive purposes — for town, irrigation and commercial supply — which was more than the 16,317 ML diverted in the previous year. Of this volume, 2,982 ML was diverted for urban use.

An additional 6,173 ML was estimated to have been used for domestic and stock purposes.

7.5.3.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs are shown in Table 7-61. Groundwater use increased in 2017–18, compared to 2016–17.

Table 7-61 Licensed groundwater volumes and use in the Portland groundwater catchment

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2017–18	Total licensed groundwater use (ML) 2016–17
Condah WSPA	70–200	7,470	3,073	2,666
Portland GMA	>200	7,794	2,501	2,389
South West Limestone GMA, Portland (2)	See note 1	37,924	13,507	10,387
Outside management units	-	4,200	927	875
Total		**57,388**	**20,008**	**16,317**

Notes

(1) From the top of the upper mid-tertiary limestone to 50 m below the upper mid-tertiary (or the base) of the limestone.

(2) The South West Limestone GMA extends into both the Hopkins–Corangamite and Glenelg groundwater catchments, and an additional 27,411 ML and 16,242 ML of entitlement volume is reported in the Hopkins–Corangamite and Glenelg catchment accounts respectively (Table 7-57 and Table 7-65). The total entitlement volume for the South West Limestone GMA as at 30 June 2018 was 54,166 ML.

An estimate of domestic and stock groundwater use is shown in Table 7-62. A number of groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed volume in Table 7-61.

Table 7-62 Number of domestic and stock bores and estimated use in the Portland groundwater catchment

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 1.5 ML per bore) (ML)
Condah WSPA	318	477
Portland GMA	1	2
South West Limestone GMA	3,902	5,853
Outside management units	212	318
Total 2017–18	**4,115**	**6,173**
Total 2016–17	4,252	6,379

Groundwater is used as an urban water supply for some towns in the Portland groundwater catchment. The licensed entitlements and metered use for these supplies are shown in Table 7-63.

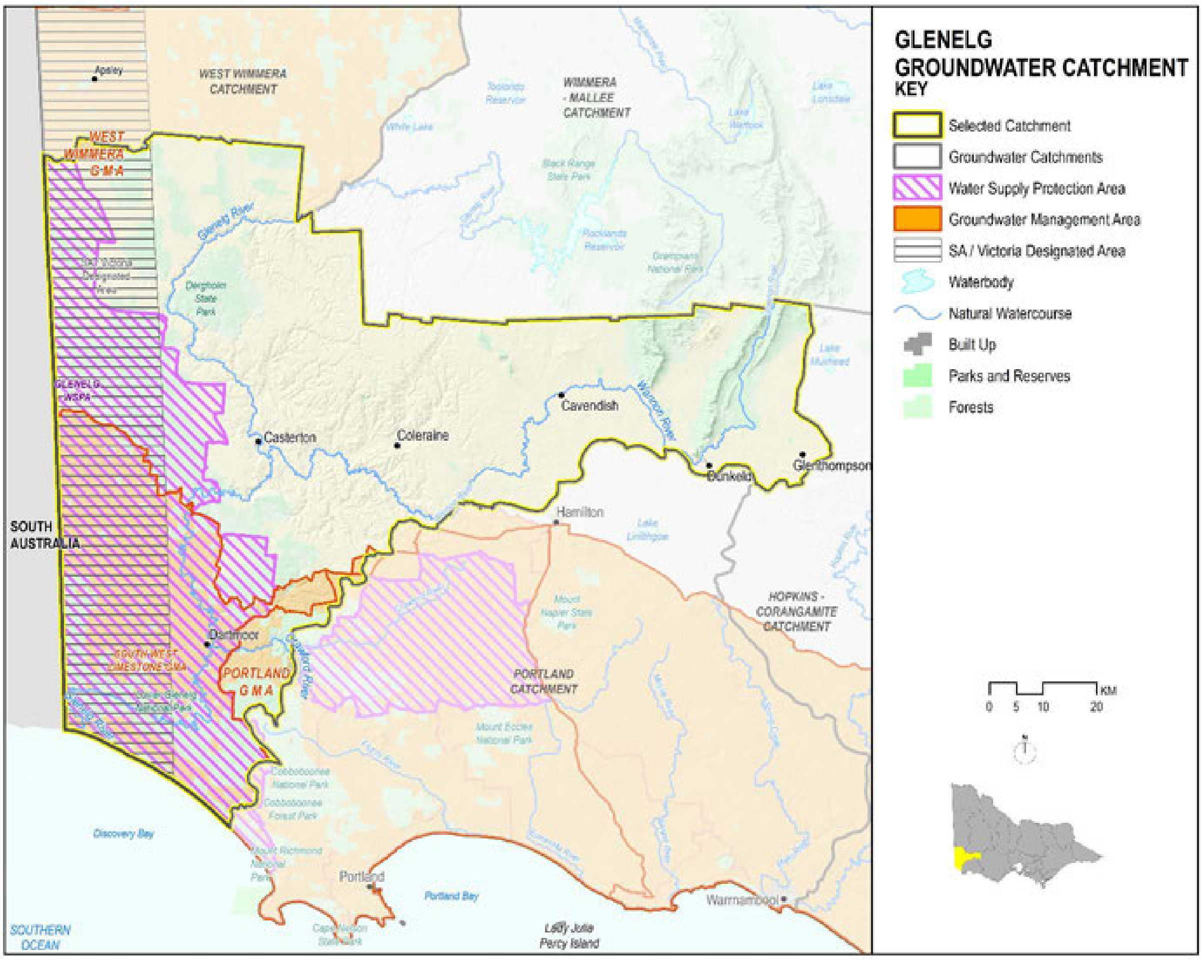
Table 7-63 Urban groundwater volumes and metered use in the Portland groundwater catchment

Town supplied	Licensed volume (ML)	Metered use 2017–18 (ML)	Metered use 2016–17 (ML)
Hamilton, Tarrington, Dunkeld	1,102	0	0
Heywood	333	159	110
Koroit	524	0	1
Macarthur	130	27	24
Penshurst	250	64	95
Port Fairy	1,026	603	589
Portland	6,222	1,738	1,717
Warrnambool, Allansford and Koroit (part)	750	391	314
Total	**10,337**	**2,982**	**2,850**

7.5.4 Glenelg groundwater catchment

The Glenelg groundwater catchment (Figure 7-18) is located in the Otway–Torquay region in western Victoria. The Victorian–South Australian border forms the western boundary of the Glenelg groundwater catchment, and the area that extends 20 km east from the border forms part of the Designated Area for the purposes of the 1985 Border Groundwaters Agreement between Victoria and South Australia. Neighbouring groundwater catchments are Portland to the south-east, Hopkins–Corangamite to the east and West Wimmera and Wimmera–Mallee to the north.

Figure 7-18 Map of the Glenelg groundwater catchment



7.5.4.1 Groundwater resources overview

Groundwater resources in the Glenelg groundwater catchment are managed by Southern Rural Water, which is responsible for developing and implementing groundwater management plans. Southern Rural Water also issues licences for groundwater use, bore construction and surface water diversions, and it administers domestic and stock use. Management responsibilities within the Designated Area are shared between Southern Rural Water and the Government of South Australia.

The Glenelg groundwater catchment contains the Glenelg WSPA, the South West Limestone GMA and a very small part of the Portland GMA (which is mostly within the Portland groundwater catchment). Groundwater resources supply licence entitlements, domestic and stock use and Casterton, Dartmoor and Merino.

The groundwater level trends for 2017–18 are shown in Table 7-64. The groundwater level trend was categorised as mostly stable throughout the year for the South West Limestone GMA, and the Glenelg WSPA level fluctuated between a stable and declining trend in 2017–18.

Table 7-64 Glenelg groundwater level trends in the Glenelg groundwater catchment

Groundwater management unit	Groundwater level trend 2017–18				Groundwater level trend June 2017
	Sep-17	Dec-17	Mar-18	Jun-18	
Water supply protection area					
Glenelg	Declining	Stable	Declining	**Stable**	**Stable**
Groundwater management area					
South West Limestone (1)	Stable	Stable	Stable	**Declining**	**Stable**

Note
(1) The South West Limestone GMA is partly contained within the Hopkins–Corangamite, Portland and Glenelg groundwater catchments.

In 2017–18, 8,807 ML of water was diverted for consumptive purposes — for town, irrigation and commercial supply — which was more than the 6,237 ML diverted in the previous year. Of this volume, 407 ML was diverted for urban use.

An additional 1,987 ML was estimated to have been used for domestic and stock purposes.

7.5.4.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs are shown in Table 7-65. Groundwater use decreased in 2017–18, compared to 2016–17.

Table 7-65 Licensed groundwater volumes and use in the Glenelg groundwater catchment

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2017–18	Total licensed groundwater use (ML) 2016–17
Glenelg WSPA	All depths	16,092	4,632	3,072
South West Limestone GMA, Glenelg (2)	See note 1	16,242	3,924	2,950
Outside management units	-	1,995	251	215
Total		**34,329**	**8,807**	**6,237**

Notes
(1) From the top of the Upper Mid-Tertiary Limestone to 50 m below the top of the Upper Mid-Tertiary Aquitard (or the base of the limestone).
(2) The South West Limestone GMA extends into both the Hopkins–Corangamite and Portland groundwater catchments, and an additional 27,411 ML and 37,924 ML of entitlement volume is reported in the Hopkins–Corangamite and Portland catchment accounts respectively (Table 7-57 and Table 7-61). The total entitlement volume for the South West Limestone GMA as at 30 June 2018 was 54,166 ML.

An estimate of domestic and stock groundwater use is shown in Table 7-66. A number of groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed volume in Table 7-65.

Table 7-66 Number of domestic and stock bores and estimated use in the Glenelg groundwater catchment

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 1.5 ML per bore) (ML)
Glenelg WSPA	1,041	1,562
South West Limestone GMA	63	95
Outside management units	220	330
Total 2017–18	**1,324**	**1,987**
Total 2016–17	1,349	2,025

Groundwater is available for urban water supply to Casterton, Dartmoor and Merino. The licensed entitlements and metered use for these supplies are shown in Table 7-67.

Table 7-67 Urban groundwater volumes and metered use in the Glenelg groundwater catchment

Town supplied	Licensed volume (ML)	Metered use 2017–18 (ML)	Metered use 2016–17 (ML)
Casterton	1,000	383	362
Dartmoor	150	24	17
Merino	100	0	0
Total	**1,250**	**407**	**379**

7.6 Wimmera–Mallee groundwater region

The Wimmera–Mallee groundwater region is located in north-western Victoria. It borders the Otway–Torquay groundwater region to the south and the Goulburn–Murray groundwater region to the east. The Wimmera–Mallee groundwater region also forms part of the Murray–Darling basin in Victoria.

The Victorian–South Australian border forms the western boundary of the Wimmera–Mallee groundwater region, and the area that extends 20 km east from the border forms part of the Designated Area for the purposes of the 2005 Border Groundwaters Agreement between Victoria and South Australia.

The northern plains of the region are dominated by sedimentary aquifers, and the southern area features fractured rock highlands extending along the Great Dividing Range.

As depth increases, the major aquifers in the region are:

- Upper Tertiary Aquifer including the Parilla Sands Aquifer, also known as the Pliocene Sands Aquifer
- Mid-Tertiary Aquifer including the Murray Group Limestone Aquifer
- Lower Tertiary Aquifer, primarily consisting of the Tertiary Confined Sands Aquifer, also known as the Renmark Group Aquifer.

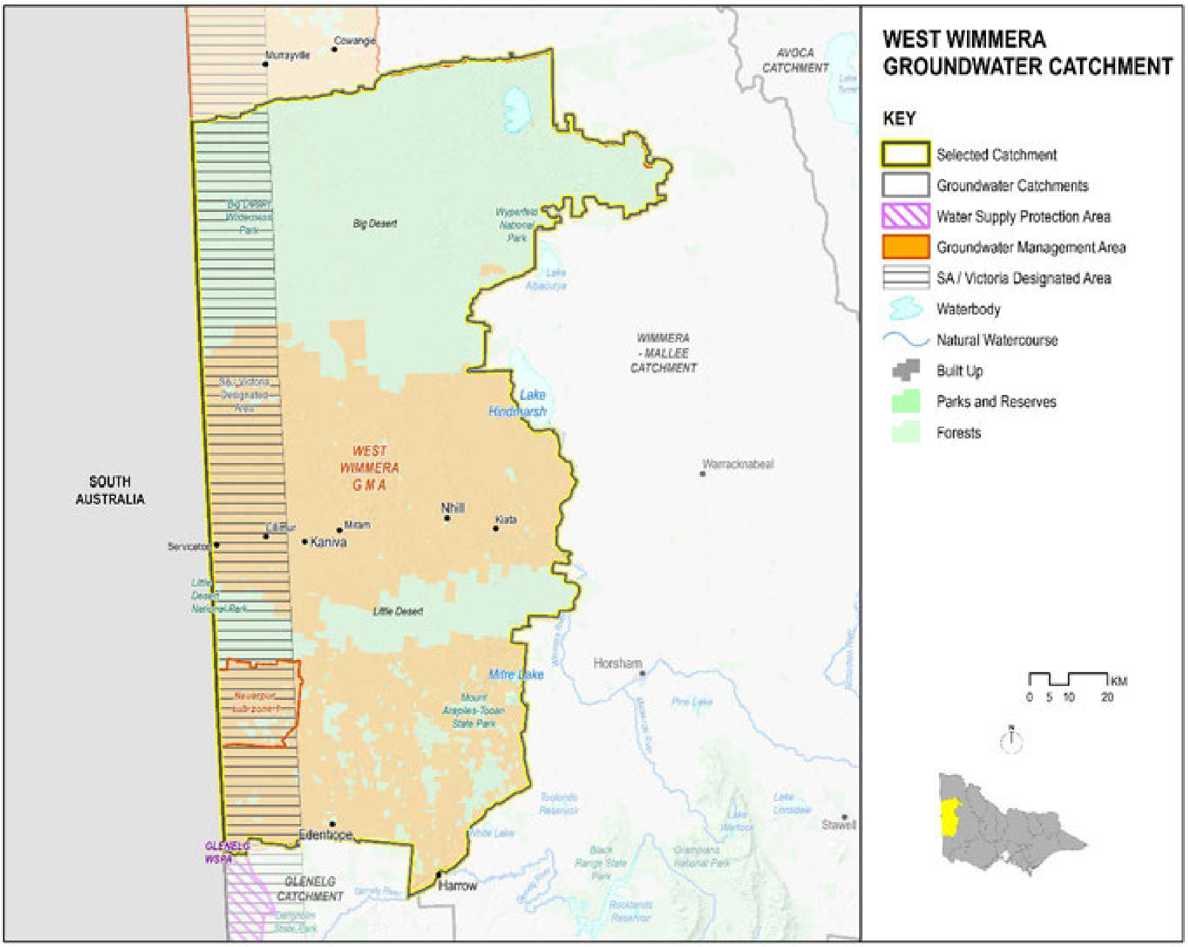
In most areas, all the aquifers are considered to be connected, with thin aquitards between the aquifers in part or all of the catchment. The Renmark Group Aquifer in the West Wimmera GMA is the exception: it is considered to be disconnected from the water above it.

Most groundwater is extracted from the Murray Group Aquifer along the border with South Australia. The water in the Murray Group is thought to originate from recharge received during a much wetter period about 20,000 years ago. The contribution of modern recharge is considered to be modest across much of the area and less than the rate of use.

7.6.1 West Wimmera groundwater catchment

The West Wimmera groundwater catchment (Figure 7-19) is located in western Victoria. The Victorian–South Australian border forms the western boundary of the West Wimmera groundwater catchment, and the area that extends 20 km east from the border forms part of the South Australia–Victoria Designated Area. Neighbouring groundwater catchments are Wimmera–Mallee to the east and north and Glenelg to the south.

Figure 7-19 Map of the West Wimmera groundwater catchment



7.6.1.1 Groundwater resources overview

Groundwater resources in the West Wimmera groundwater catchment are managed by Grampians Wimmera Mallee Water, which is responsible for developing and implementing groundwater management plans. Grampians Wimmera Mallee Water also issues licences for groundwater use, bore construction and surface water diversions, and it administers domestic and stock use. Management responsibilities within the Designated Area are shared between Grampians Wimmera Mallee Water and the Government of South Australia.

The West Wimmera groundwater catchment contains the West Wimmera GMA. Groundwater resources are used for irrigation, domestic and stock water and to supply the townships of Apsley, Harrow, Miram, Serviceton, Edenhope, Kiata, Goroke, Lillimur, Kaniva and Nhill.

In the West Wimmera groundwater catchment, licence holders in the Neuarpur subzone 1 (a trading zone in the West Wimmera GMA) are restricted to 80 percent of their licence volume.

The groundwater level trends for 2017–18 are shown in Table 7-68. Although groundwater level trends in the West Wimmera GMA were categorised as stable throughout the year, levels in the Neuarpur subzone 1 (in the western part of the catchment) have historically been declining.

Table 7-68 West Wimmera groundwater level trends

Groundwater management unit	Groundwater level trend 2017–18				Groundwater level trend June 2017
	Sep-17	Dec-17	Mar-18	Jun-18	
Groundwater management area					
West Wimmera	Stable	Stable	Stable	**Stable**	**Stable**
West Wimmera - Neuarpur subzone1 [(1)]	Declining	Declining	Declining	**Declining**	**Declining**

Note
(1) Restrictions on seasonal allocations are in place to address the trend deviation in the Neuarpur subzone in the West Wimmera GMA.

In 2017–18, 27,310 ML of water was diverted for consumptive purposes — for town, irrigation and commercial supply — which was more than the 24,428 ML diverted in the previous year. Of this volume, 584 ML was diverted for urban use.

An additional 1,248 ML was estimated to have been used for domestic and stock purposes.

7.6.1.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs are shown in Table 7-69. Groundwater use increased in 2017–18, compared to 2016–17.

In line with the West Wimmera GMA strategy (which assists with managing the declining levels in the western part of the West Wimmera groundwater catchment), an 80 percent seasonal allocation remained in place in the Neuarpur subzone 1 — a trading zone in the West Wimmera GMA — in 2017–18.

Table 7-69 Licensed groundwater volumes and use in the West Wimmera groundwater catchment

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2017–18	Total licensed groundwater use (ML) 2016–17
West Wimmera GMA	All depths	53,603	27,310	24,428
Total		**53,603**	**27,310**	**24,428**

An estimate of domestic and stock groundwater use is shown in Table 7-70. A number of groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed volume in Table 7-69.

Table 7-70 Number of domestic and stock bores and estimated use in the West Wimmera groundwater catchment

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 2.0 ML per bore) (ML)
West Wimmera GMA	623	1,246
Outside management units	1	2
Total 2017–18	**624**	**1,248**
Total 2016–17	639	1,278

Groundwater is available for urban water supply to Apsley, Edenhope, Goroke, Harrow, Kaniva, Kiata, Lillimur, Miram, Nhill and Serviceton. The licensed entitlements and metered use for these supplies are shown in Table 7-71.

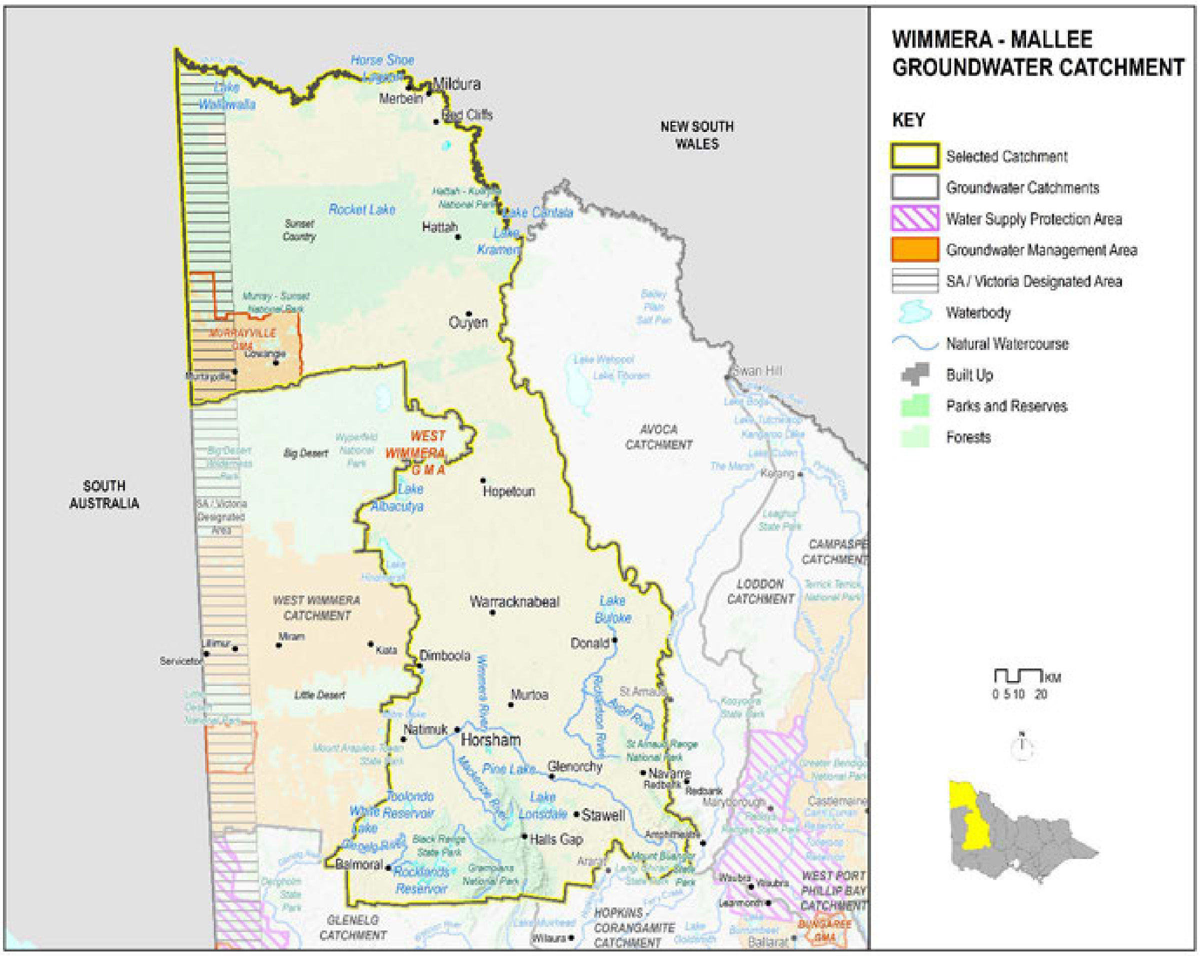
Table 7-71 Urban groundwater volumes and metered use in the West Wimmera groundwater catchment

Town supplied	Licensed volume (ML)	Metered use 2017–18 (ML)	Metered use 2016–17 (ML)
Apsley	40	27	10
Edenhope	250	130	133
Goroke	86	52	45
Harrow	60	46	33
Kaniva	600	197	173
Kiata	40	5	5
Lillimur	32	7	7
Miram	7	1	1
Nhill	1,000	112	120
Serviceton	25	7	10
Total	**2,140**	**584**	**537**

7.6.2 Wimmera–Mallee groundwater catchment

The Wimmera–Mallee groundwater catchment (Figure 7-20) is located in north-western Victoria. Neighbouring groundwater catchments are West Wimmera to the west, Avoca to the east and Glenelg and Hopkins–Corangamite to the south.

Figure 7-20 Map of the Wimmera–Mallee groundwater catchment



7.6.2.1 Groundwater resources overview

Groundwater resources in the Wimmera–Mallee groundwater catchment are managed by Grampians Wimmera Mallee Water, which is responsible for developing and implementing groundwater management plans. Grampians Wimmera Mallee Water also issues licences for groundwater use, bore construction and surface water diversions, and it administers domestic and stock use. The Wimmera–Mallee groundwater catchment forms part of the Murray–Darling basin and groundwater management arrangements are subject to the requirements of the Murray–Darling Basin Plan. Management responsibilities within the Designated Area are shared between Grampians Wimmera Mallee Water and the Government of South Australia.

The Wimmera–Mallee groundwater catchment contains the Murrayville GMA. The Murrayville GMA local management plan was approved in July 2017, replacing the statutory groundwater plan which was revoked by the Minister for Water on 13 July 2017. The area of the GMA is larger, as it incorporates land and associated licensed entitlement that existed in the unincorporated area east of the boundary of the original WSPA, and the PCV limit has also been increased to include this existing entitlement.

Groundwater resources supply licence entitlements, domestic and stock use and Cowangie, Horsham, Landsborough and Murrayville. Groundwater resources from the Wimmera–Mallee groundwater catchment also supply Willaura, though the town itself is located outside the groundwater catchment.

The groundwater level trends for 2017–18 are shown in Table 7-72. In 2017–18, the groundwater level trend in the Murrayville GMA was categorised as stable.

Table 7-72 Groundwater management unit trends

Groundwater management unit	Groundwater level trend 2017–18				Groundwater level trend June 2017
	Sep-17	Dec-17	Mar-18	Jun-18	
Groundwater management area					
Murrayville	Stable	Stable	Stable	Stable	Stable

In 2017–18, 8,598 ML of water was diverted for consumptive purposes — for town, irrigation and commercial supply — which was more than the 6,263 ML diverted in the previous year. Of this volume, 363 ML was diverted for urban use.

An additional 866 ML was estimated to have been used for domestic and stock purposes.

7.6.2.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs are shown in Table 7-73. There was more groundwater use within the catchment in 2017–18, compared to 2016–17.

Table 7-73 Licensed groundwater volumes and use in the Wimmera–Mallee groundwater catchment

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2017–18	Total licensed groundwater use (ML) 2016–17
Murrayville GMA	70–200	9,755	8,331	5,805
Outside management units	-	6,550	267	458
Total		**16,305**	**8,598**	**6,263**

An estimate of domestic and stock groundwater use is shown in Table 7-74. A number of groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed volume in Table 7-73.

Table 7-74 Number of domestic and stock bores and estimated use in the Wimmera–Mallee groundwater catchment

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 2.0 ML per bore) (ML)
Murrayville GMA	183	366
Outside management units	250	500
Total 2017–18	**433**	**866**
Total 2016–17	443	886

Groundwater is used for urban water supply to Cowangie, Horsham, Landsborough, Murrayville and Willaura. The licensed entitlements and metered use for these supplies are shown in Table 7-75.

Table 7-75 Urban groundwater volumes and metered use in the Wimmera–Mallee groundwater catchment

Town supplied	Licensed volume (ML)	Metered use 2017–18 (ML)	Metered use 2016–17 (ML)
Cowangie	40	7	9
Horsham Mt Zero	1,200	22	21
Landsborough	150	37	32
Murrayville	475	123	100
Willaura system	220	174	146
Total	**2,085**	**363**	**308**

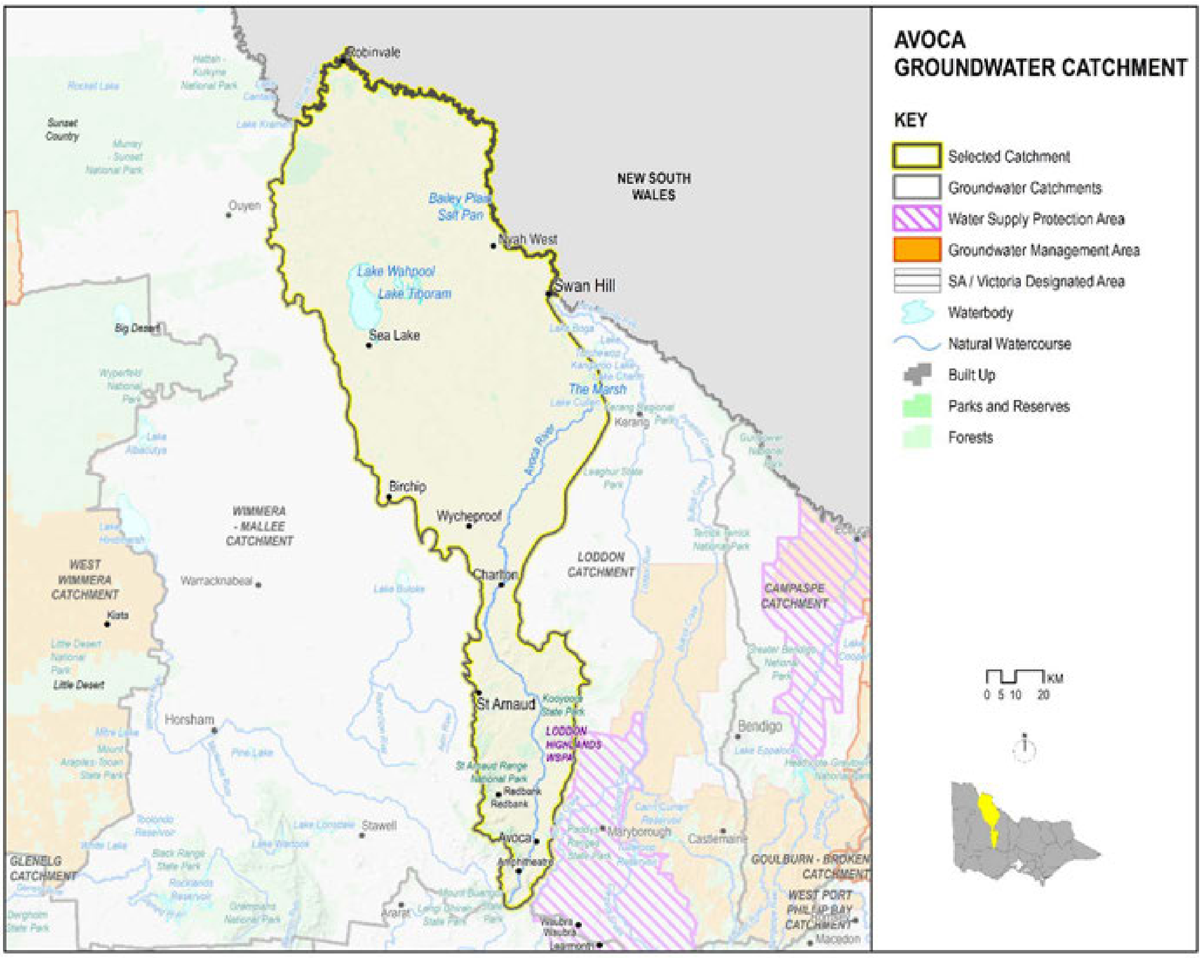
Note

(1) While Willaura is located in the Hopkins–Corangamite groundwater catchment, the bores that supply the town are in the Wimmera–Mallee groundwater catchment at Mafeking.

7.6.3 Avoca groundwater catchment

The Avoca groundwater catchment is in north-western Victoria (Figure 7-21). Neighbouring groundwater catchments are Wimmera–Mallee to the west and Loddon to the east.

Figure 7-21 Map of the Avoca groundwater catchment



7.6.3.1 Groundwater resources overview

Groundwater resources in the Avoca groundwater catchment are mainly managed by Grampians Wimmera Mallee Water, which is responsible for developing and implementing groundwater management plans. Grampians Wimmera Mallee Water also issues licences for groundwater use, bore construction and surface water diversions, and it administers domestic and stock use. Central Highlands Water also supplies groundwater to Amphitheatre, Avoca and Redbank.

The Avoca groundwater catchment forms part of the Murray–Darling basin, and groundwater management arrangements are subject to the requirements of the Murray–Darling Basin Plan.

The Avoca groundwater catchment does not contain any GMAs or WSPAs.

In 2017–18, 1,363 ML of water was diverted for consumptive purposes — for town, irrigation and commercial supply — which was more than the 607 ML diverted in the previous year. Of this volume, 195 ML was diverted for urban use.

An additional 122 ML was estimated to have been used for domestic and stock purposes.

7.6.3.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from across the catchment are shown in Table 7-76. Groundwater use increased in 2017–18, compared to 2016–17.

Table 7-76 Licensed groundwater volumes and use in the Avoca groundwater catchment

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2017–18	Total licensed groundwater use (ML) 2016–17
Outside management units	-	2,572	1,363	607
Total		**2,572**	**1,363**	**607**

An estimate of domestic and stock groundwater use is shown in Table 7-77. A number of groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed volume in Table 7-76.

Table 7-77 Number of domestic and stock bores and estimated use in the Avoca groundwater catchment

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 2 ML per bore) (ML)
Outside management units	61	122
Total 2017–18	**61**	**122**
Total 2016–17	63	126

Groundwater is used to provide urban water supply to three towns in the Avoca groundwater catchment. The licensed entitlements and metered use for these supplies are shown in Table 7-78. Groundwater use increased in 2017–18, compared to 2016–17.

Table 7-78 Urban groundwater volumes and metered use in the Avoca groundwater catchment

Town supplied	Licensed volume (ML)	Metered use 2017–18 (ML)	Metered use 2016–17 (ML)
Amphitheatre	20	3	1
Avoca	250	188	176
Redbank	50	4	3
Total	**320**	**195**	**180**

8. Distribution system water accounts

8.1 Methodology

This chapter provides the water accounts for each of Victoria's 19 distribution systems. It describes the movement of water through the constructed distribution systems that deliver water to users. These accounts track the water from the time it moves from a waterway, an aquifer or other source to the time it is delivered to a customer or another destination.

Distribution systems typically supply within irrigation districts or towns and urban areas. Some infrastructure services both of these end uses. On occasion, environmental entitlements are supplied using the distribution systems. Providing water accounts for distribution systems enable water corporations and the community to understand where delivery efficiency improvements to reduce losses can most readily be made.

A distribution system is the infrastructure constructed, maintained and owned by a water corporation that is used to distribute water from its source to a user. Distribution systems begin where water is taken from a source waterway or aquifer and end where the water is delivered to a customer.

These distribution system accounts include two components – bulk and reticulation. The bulk or feed infrastructure is used for large transfers of water and includes off-stream storages, bulk supply channels and treatment plants. The reticulation networks comprise the smaller infrastructure (such as pipes) to deliver water to each individual customer.

On-stream storages (for example, Lake Eildon) are not considered to be part of distribution systems as they are already covered in chapter 6.

An off-stream storage often has a certain amount of catchment inflows (that is, it has some on-stream characteristics). The bulk water entitlements that authorise water being taken from waterways serve as a guide to whether a storage is off-stream.

As far as possible, the accounts have been prepared on a consistent basis, while recognising the substantial differences between systems.

8.1.1 Groupings of distribution systems

Distribution system reporting is grouped by water corporation ownership. This reflects the fact that as water is moved from its source to a user, it may pass through more than one distribution system. For example, Melbourne Water uses its distribution system to divert water from its source and supply it to Melbourne retail water corporations. Then, the Melbourne retail water corporations take that water into their own distribution systems and supply it to their customers.

Distribution systems (except for the Goldfields Superpipe) are all operated by a single water corporation and are generally located in one of the four regions — Northern, Gippsland, Central and Western. Southern Rural Water operates three irrigation systems: one in the Gippsland region and two in the Central region. Southern Rural Water systems therefore appear in two regions: Central and Gippsland.

Most water corporations have diagrams or maps of their distribution systems on their websites.

Distribution system boundaries do not necessarily align with river basin boundaries. For example, Goulburn–Murray Water's Goulburn system straddles the Goulburn, Campaspe and Loddon basins, and it also supplies water further west into the Avoca basin.

8.1.2 Types of distribution systems

For consistency, the following definitions are used.

Common distribution system

A common distribution system is a bulk or feeder system that mainly supplies two or more distribution systems. It may have few or no retail customers. Examples include Melbourne Water's system, the Goldfields Superpipe (operated jointly by Coliban Water and Central Highlands Water) and the Waranga Western Channel (which supplies several irrigation and other systems including the Goldfields Superpipe).

Rural distribution system

A rural distribution system is an irrigation system which primarily supplies irrigation water, although it may also supply other commercial customers, urban systems and domestic and stock water; or a domestic and stock system which primarily supplies non-irrigation rural customers and may also supply urban systems.

Urban distribution system

An urban distribution system is a system that primarily supplies urban customers. It may supply a single town or a group of towns, and it may also transfer water to other distribution systems. As explained above, an urban distribution system may have feeder and reticulation components, with the water balance for the two components shown separately.

Combined distribution system

A combined distribution system is a system that consolidates urban and rural components. For example, Wannon Water and Grampians Wimmera Mallee Water both operate rural distribution systems that supply several towns as well as rural customers. While deliveries to different customer groups can usually be separated (for example, deliveries to towns can be identified and shown separately to deliveries to rural customers), inflows and distribution losses often cannot be separated.

8.1.3 Data sources and limitations

Almost all the data used for the accounts was provided by the water corporations that operate the systems. They obtained the data using various types of meters, various methods of infilling data when meters fail, hydrographic measurement, hydrologic techniques to estimate inflows they did not measure, and back-calculation. Details of these methods are available from the relevant corporation and are not necessarily included in notes to the accounts, which are as concise as possible.

The presentation of the accounts is consistent with the Australian Water Accounting Standards developed under the auspices of the Council of Australian Governments. For example, though some accounting approaches would report net evaporation from a storage as a loss, these accounts treat data on rainfall and evaporation as separate inflows and outflows. This may affect efficiency and loss measures, but the differences when compared to traditional figures are generally small.

8.1.4 Losses

Losses in the distribution system accounts represent the amount of water lost after the point of extraction from a river or other water system. The amount lost is any volume taken from the source but not delivered in a useful way to customers or other systems. The loss will be the difference between the inflows to the system and the known deliveries and outflows. Depending on the system, the loss may comprise of reticulation losses, treatment plant losses and other system losses:

- reticulation losses represent the loss in the actual reticulation system (the series of pipes connecting customers)
- treatment plant losses represent the loss incurred during the water treatment process
- other system losses typically represent the loss of water from the point of extraction and the actual reticulation system, and it is a balancing item. An example of this portion of the loss is evaporation or seepage of water out of an open channel carrying water from a river to a treatment plant.

As these types of losses are not consistently provided by, or recorded by the water businesses, the tables in these accounts show a single line item for ‘system losses’.

8.1.5 Efficiency calculations

System efficiency calculations for these accounts are based on the formula *Efficiency = 100 x (delivered to customers + passed to other systems) / total outflows*. DELWP recognises that the system efficiency formula is only one of many commonly used in the water industry.

‘Total outflows’ includes all the end uses of water received by the distribution system (the inflows). It includes deliveries to customers and water passed to other systems — these two together constitute useful deliveries — plus losses.

The reports classify outfalls at the end of channels as water passed to other systems if they are regulated to a river, wetland or downstream distribution system. Outfalls due to cancelled water orders already in delivery (also known as rain rejections) or inaccuracies in system regulation are classified as a distribution system loss, even though they may turn up in the downstream system as an unregulated inflow.

Some cases do not fit the above classifications and call for a commonsense approach. For example, at Loddon Weir in periods of regulated flows, inflows are received from the Loddon River into the Waranga Western Channel and regulated westward along the channel, leaving minimum flows to be passed downstream. In wet periods, almost all the Loddon Weir inflows simply pass downstream because there is no capacity to reregulate them. In both cases, it is common sense to record all Loddon Weir inflows as inflows to the channel and all water passed to the Loddon Weir as passed to other systems, to achieve a reasonable indication of distribution system efficiency.

In systems where there is a large balancing item (which implies poor measurement somewhere), the efficiency calculation may be relatively meaningless. In such cases, no calculated figure is shown in the tables and efficiency is simply recorded as ‘n/a’ (not applicable). In other cases, small measurement errors or unmeasured inflows result in a calculated efficiency higher than 100%, which is reported as such.

The efficiency figures that water corporations include in their annual reports and provide to the Essential Services Commission are often for the reticulation component of a distribution system, rather than for off-stream storages and treatment plants, as is essential in the present accounts. As explained above, sometimes it makes sense to show feeder and reticulation components separately. More corporations may choose to do this in future.

8.2 Interpreting and using the distribution system water accounts

The accounts in this chapter are summarised: the full account for a system has usually been condensed to a single line in a table. Nonetheless, the accounts are useful for drawing attention to possible management issues. For example, an unusually low distribution efficiency could occur due to:

- poor or difficult measurement
- the system configuration giving rise to intrinsically low efficiency (an example would be where a system has a storage with high evaporation; management options to improve the situation are limited, although they exist)
- inadequately maintained infrastructure or infrastructure that cannot be improved economically
- relatively high treatment system losses in small, urban systems
- unmeasured deliveries for purposes such as firefighting and transport by tanker as a drought-relief measure.

Conversely, unusually high efficiency can be the result of poor measurement, unmeasured inflows or other unknown factors.

The accounts can only indicate a possible issue: managers would need to investigate and analyse an issue before determining their response. Any management response would, of course, need to be cost-effective.

8.3 Northern region

8.3.1 North East Water

North East Water provides water and sewerage services to 39 towns in north-eastern Victoria. It supplies water to customers in urban areas, sourcing that water from Goulburn–Murray Water, which manages water storage, delivery and drainage systems.

North East Water serves an estimated 108,000 people in an area of about 20,000 km^2. The area extends from Corryong in the east along the Murray River to Yarrawonga, then south to Benalla and to Bright, Mount Beauty and Dartmouth in the Victorian Alps. Table 8-1 summarises North East Water's urban distribution systems.

Table 8-1 North East Water urban distribution systems

Area	System / towns supplied	Source of supply	Treatment plant location
Alpine area	Bright system: Bright, Wandiligong and Porepunkah	Unregulated Ovens River, groundwater	Bright
	Harrietville	Unregulated Ovens River and Simmons Creek	Harrietville
	Mount Beauty system: Tawonga, Tawonga South and Mount Beauty	West Kiewa River	Tawonga South
	Myrtleford	Buffalo Creek	Myrtleford
Broken River	Benalla	Ryan and Whiskey creeks	Benalla
King and Ovens rivers	Moyhu	Regulated King River	Moyhu
	Oxley	Regulated King River	Oxley
	Wangaratta group: Wangaratta and Glenrowan	Regulated Ovens River, groundwater	Wangaratta
	Whitfield	King River, Musk Gully Creek	Whitfield
Mitta Mitta River	Dartmouth	Mt Tabor Creek	Dartmouth
	Eskdale	Regulated Mitta Mitta River	Eskdale
Murray River	Bellbridge	Lake Hume	Bellbridge
	Rutherglen/Wahgunyah system	Regulated Murray River	Wahgunyah
	Tallangatta	Lake Hume	Tallangatta
	Wodonga system: Wodonga, Baranduda, Kiewa, Springhurst, Tangambalanga, Bonegilla, Ebden, Barnawartha and Chiltern	Regulated Murray River	Wodonga
	Yarrawonga system: Yarrawonga, Tungamah, St James, Bundalong and Devenish	Regulated Murray River	Yarrawonga
Subalpine area	Beechworth	Nine Mile Creek Frenchmans Creek Lake Kerferd catchment	Beechworth
	Yackandandah	Nine Mile Creek	Yackandandah
Upper Murray	Corryong system: Corryong and Cudgewa	Nariel Creek	Corryong
	Walwa	Unregulated Murray River, Corryong system	Walwa
Supplied by groundwater	Goorambat	Groundwater, Yarrawonga system	Goorambat

Table 8-2 summarises North East Water's urban distribution systems' water balances.

Table 8-2 North East Water urban distribution systems' water balances

Area / town / system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)					End volume in store (ML)	Distribution system efficiency (%)
			Urban residential deliveries	Urban non-residential deliveries	System losses	Passed to other systems	Total outflows		
Alpine area									
Bright system	76	907	301	158	484	0	943	39	49%
Harrietville	0.3	61.7	27.9	16.6	17.2	0	62	0.5	72%
Mount Beauty system	2	254	165	54	32	0	251	5	87%
Myrtleford (1)	306	526	259	216	126	0	601	231	79%
Broken River									
Benalla	9	1,517	942	338	230	0	1,510	16	85%
Kings and Ovens rivers									
Moyhu	0.1	30.8	20.7	4.8	5.1	0	31	0.3	83%
Oxley	0.2	58.8	37.6	0.8	20.4	0	59	0.2	65%
Wangaratta group	29	3,572	1,872	1,108	586	0	3,566	35	84%
Whitfield	0.2	21.9	13.2	3.6	4.7	0	22	0.5	78%
Mitta Mitta River									
Dartmouth	0.2	22.8	12.0	6.1	4.6	0	23	0.3	80%
Eskdale	0.1	14.3	6.7	5.1	2.5	0	14	0.2	83%
Murray River									
Bellbridge	0.5	53.0	39.7	1.4	11.9	0	53	0.5	78%
Rutherglen/Wahgunyah system	6	681	405	173	103	0	681	7	85%
Tallangatta	2	163	78	40	45	0	163	2	72%
Wodonga system	88	7,146	3,873	2,286	1,000	0	7,159	75	86%
Yarrawonga system	11	1,667	1,058	206	390	12	1,666	12	76%
Sub-alpine area									
Beechworth (1)	658	784	303	164	456	0	923	519	51%
Yackandandah	24	179	73	43	68	0	183	20	63%
Upper Murray River									
Corryong system	76	279	115	52	93	3	262	92	63%
Walwa (2)	1	17	8	10	-1	0	17	1	n/a
Supplied from groundwater									
Goorambat (3)	0	22	10	1	11	0	21	0	51%

Notes

(1) For the Myrtleford and Beechworth systems, the distribution system efficiency includes allowance for evaporation.

(2) The balancing item in these accounts is usually losses; however, adding the balancing item in this system would cause the loss to be reported as negative. In this case, the unattributed volume has been assigned to the total inflows column. Due to this uncertainty, no efficiency measure is reported for this year.

(3) Goorambat was connected to the Yarrawonga system in December 2017, and it receives treated water from Yarrawonga. The losses associated with commissioning of the new pipeline are shown in the Gooramat system.

n/a Not applicable.

8.3.2 Goulburn Valley Water

Goulburn Valley Water provides urban water and wastewater services to over 125,000 people. It services about 57,500 properties in 54 localities, from the outskirts of Melbourne in the south to the Murray River in the north. Bulk water supply is principally from the Goulburn, Broken, Murray, Steavenson, Rubicon and Delatite rivers, and from some smaller local streams (such as Sunday Creek and Seven Creeks).

Table 8-3 summarises Goulburn Valley Water's urban distribution systems.

Table 8-3 Goulburn Valley Water urban distribution systems

Area	System / towns supplied	Source of supply	Treatment plant location / comment
Broken Creek	Nathalia	Broken Creek	Nathalia
Goulburn channels	Towns supplied from Central Goulburn Irrigation Area: Tatura, Kyabram, Tongala, Girgarre, Stanhope, Merrigum and Rushworth	Central Goulburn Irrigation Area	At each town except Merrigum, which is supplied from Kyabram
	Towns supplied from Rochester Irrigation Area: Colbinabbin and Corop	Rochester Irrigation Area	Colbinabbin
	Towns supplied from Shepparton Irrigation Area: Dookie and Katandra West	Shepparton Irrigation Area	At each town
Goulburn River	Alexandra	Regulated Goulburn River	Alexandra
	Murchison	Regulated Goulburn River	Murchison
	Nagambie system: Nagambie, Kirwan's Bridge and Baxter	Regulated Goulburn River	Nagambie
	Seymour system: Seymour, Avenel, Mangalore and Tallarook	Regulated Goulburn River	Seymour
	Shepparton system: Shepparton, Mooroopna, Congupna, Toolamba and Tallygaroopna	Regulated Goulburn River	Shepparton
	Woods Point	Brewery Creek	Woods Point
Goulburn River tributaries	Broadford system: Broadford and Waterford Park (Clonbinane)	Sunday Creek Reservoir and regulated Goulburn River at Tallarook	Broadford
	Euroa system: Euroa, Strathbogie and Violet Town	Seven Creeks	Euroa
	Kilmore system: Kilmore, Wandong and Heathcote Junction	Sunday Creek Reservoir, Hazels Creek	Kilmore
	Longwood	Nine Mile Creek	Longwood
	Mansfield	Delatite River	Mansfield
	Marysville & Buxton	Steavenson River	Marysville
	Pyalong	Mollisons Creek	Pyalong
	Thornton	Rubicon River, Alexandra system	Thornton
	Upper Delatite system: Upper Delatite, Sawmill Settlement and Merrijig	Delatite River	Sawmill Settlement
	Yea system: Yea and Molesworth	Yea River	Yea
Lake Eildon	Eildon and Bonnie Doon	Brankeet Creek / Lake Eildon, Alexandra system	Bonnie Doon
Murray channels	Katamatite and Picola	Murray Valley Irrigation Area	At each town
	Numurkah system: Numurkah and Wunghnu	Murray Valley 6/6 Channel	Numurkah
Murray River	Barmah	Murray River	Barmah
	Cobram system: Cobram, Strathmerton and Yarroweyah	Murray River	Cobram
Supplied from groundwater	Katunga	Groundwater	Disinfection only

Table 8-4 shows Goulburn Valley Water's urban distribution systems' water balances.

Table 8-4 Goulburn Valley Water urban distribution systems' water balances

Area/system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)					End volume in store (ML)	Distribution system efficiency (%)
			Urban residential deliveries	Urban non-residential deliveries	System losses	Passed to other systems (1)	Total outflows		
Broken Creek									
Nathalia	0	491	228	91	172	0	491	0	65%
Goulburn channels									
Towns supplied from Central Goulburn IA	644	5,156	1,814	2,633	710	0	5,156	644	86%
Towns supplied from Rochester IA	0	40	24	13	3	0	40	0	92%
Towns supplied from Shepparton IA	0	156	64	43	48	0	156	0	69%
Goulburn River									
Alexandra	0	581	213	90	93	185	581	0	84%
Murchison	0	193	103	35	54	0	193	0	72%
Nagambie system	0	491	205	206	80	0	491	0	84%
Seymour system	0	1,563	857	334	372	0	1,563	0	76%
Shepparton system	0	12,738	6,335	4,266	2,138	0	12,738	0	83%
Woods Point	0	8	5	2	0	0	8	0	95%
Goulburn River tributaries									
Broadford system	104	566	384	107	85	0	576	94	85%
Euroa system	660	1,086	463	165	550	0	1,178	569	53%
Kilmore system	63	1,566	722	200	638	0	1,560	69	59%
Longwood	27	66	35	12	19	0	66	27	71%
Mansfield	561	817	340	142	334	0	815	563	59%
Marysville & Buxton	97	375	86	34	259	0	379	93	32%
Pyalong	37	50	38	11	21	0	70	17	70%
Thornton	0	33	17	7	9	0	33	0	73%
Upper Delatite system	0	117	67	28	22	0	117	0	81%
Yea system	0	227	157	52	18	0	227	0	92%
Lake Eildon									
Eildon and Bonnie Doon	48	218	126	39	51	0	216	50	76%
Murray channels									
Katamatite and Picola	16	74	29	35	10	0	74	16	87%
Numurkah system (2)	0	1,000	643	361	-4	0	1,000	0	n/a
Murray River									
Barmah	0	58	31	13	14	0	58	0	76%
Cobram system	0	2,883	758	1,328	797	0	2,883	0	72%
Supplied from groundwater									
Katunga	0	49	24	20	5	0	49	0	90%

Notes

(1) 'Passed to other systems' includes estimated water treatment supernatant / backwash water returned to wastewater management facilities, rivers and channel systems (based on Goulburn Valley Water's 2012 water plan demand strategy forecast).

(2) Goulburn Valley Water has reported a negative loss in this system. This infers that there is some uncertainty around the figures. Due to this uncertainty, no efficiency measure has been reported in the system for this year.

n/a Not applicable.

8.3.3 Goulburn–Murray Water

Goulburn–Murray Water manages water-related services for an area of 68,000 km^2 bordered by the Great Dividing Range in the south and the Murray River in the north and stretching from Corryong in the east down-river to Nyah. It supplies irrigators and other rural water users and provides bulk water supply to many towns within irrigation areas and along regulated rivers.

It operates two common distribution systems:

- the Waranga Western Channel
- the Victorian Mid-Murray Storages and associated bulk carriers.

It also operates nine irrigation and six other rural distribution systems, as shown in Table 8-8.

8.3.3.1 Waranga Western Channel

The Waranga Western Channel sources most of its water from the Goulburn River at Goulburn Weir and is supplemented by extractions from the Campaspe and Loddon rivers. The major supply channels of Stuart Murray Canal and Cattenach Canal are included in the channel. It supplies water to three irrigation areas, three domestic and stock areas and to Bendigo and Ballarat via the Goldfields Superpipe. The Waranga basin, a substantial off-stream storage, is also included in the channel. It has been divided into three segments because it crosses three river basins: the division facilitates cap reporting to the Murray–Darling Basin Authority.

The water balance, divided into its three segments, is shown in Table 8-5.

Table 8-5 Waranga Western Channel water balance

Waranga Western Channel	Goulburn segment (ML)	Campaspe segment (ML) (1)	Loddon segment (ML) (2)	Eliminations (ML) (3)	Total (ML)
Volumes in store					
Start volume in store (1 July 2017)					
Waranga basin	227,274				227,274
Greens Lake		22,599			22,599
End volume in store (30 June 2018)					
Waranga basin	197,619				197,619
Greens Lake		20,806			20,806
Change in storage	**(29,655)**	**(1,793)**			**(31,448)**
Inflows					
From Goulburn River	795,571				795,571
Rainfall on Waranga basin	24,238				24,238
From WWC Goulburn segment		429,459		(429,459)	0
From Cornella Creek		15,643			15,643
Rainfall on Greens Lake		969			969
From WWC Campaspe segment			216,005	(216,005)	0
From Loddon River			37,707		37,707
Unattributed inflows	37,840				37,840
Total inflows	**857,649**	**446,071**	**253,712**	**(645,464)**	**911,968**
Outflows					
Passed to other systems					0
To Central Goulburn Irrigation area	376,329				376,329
To Goldfields superpipe					0
To WWC Campaspe segment	429,459			(429,459)	0
To Rochester Irrigation Area		187,781			187,781
To WWC Loddon segment		216,005		(216,005)	0
To Loddon Valley Irrigation Area			226,116		226,116
To Campaspe River		38,987			38,987
To Loddon River			27,596		27,596
Total passed to other systems	**805,788**	**442,773**	**253,712**	**(645,464)**	**856,809**
Losses					
Evaporation from Waranga basin	81,516				81,516
Evaporation from Greens Lake		5,091			5,091
Unattributed outflows					0
Total losses	**81,516**	**5,091**	**0**		**86,607**
Total outflows	**887,304**	**447,864**	**253,712**	**(645,464)**	**943,416**

Note

(1) The eliminations column removes the internal transfers between components of the Waranga Western Channel to enable a total balance for the channel to be presented in the Total column in the table.

8.3.3.2 Victorian Mid-Murray Storages

The Victorian Mid-Murray Storages (VMMS) concept was introduced as a means of capturing a portion of the increased unregulated Victorian tributary flows into the Murray River resulting from the decommissioning of Lake Mokoan in the Broken River basin. These unregulated flows occur mainly from May to November.

The VMMS consists of Kow Swamp, Lake Boga, Lake Charm and Kangaroo Lake, which have a combined capacity of around 151,100 ML. They are connected by a number of bulk carriers, for which losses are apportioned.

Each year, an average of 22,100 ML a year is harvested into Lake Boga, Lake Charm and Kangaroo Lake, and released. The capture of water offsets the reduction of the required annual release from the Snowy River to the upper

Murray by retaining some unregulated flows in Victoria. The water is available to supplement Victoria's Murray resource.

Table 8-6 shows the water balance for the VMMS.

Table 8-6 Victorian Mid-Murray Storages water balance

Victorian Mid-Murray Storages	Volume (ML)
Volumes in store	
Start volume in store (1 July 2017)	
Total Kow Swamp, Lake Charm, Kangaroo Lake, Lake Boga	117,817
End volume in store (30 June 2018)	
Total Kow Swamp, Lake Charm, Kangaroo Lake, Lake Boga	116,074
Change in storage	**(1,743)**
Inflows	
Rain on all storages	13,322
Inflows from Torrumbarry Irrigation Area	179,716
Total inflows	**193,038**
Outflows	
Passed to other systems	
Lake Charm to Murray River	0
Lake Boga to Murray River	5,055
6/7 channel to Murray River	7,369
Kerang Weir to Murray River	111,216
Victorian Mid-Murray Storages to Torrumbarry Irrigation Area	2,849
Total passed to other systems	**126,489**
Losses	
Evaporation on storages	56,850
System losses (1)	11,442
Total losses	**68,292**
Total outflows	**194,781**

Note

(1) Fixed allowance for system losses.

8.3.3.3 Other distribution systems

Goulburn–Murray Water's other distribution systems are rural and are summarised in Table 8-7.

Table 8-7 Goulburn–Murray Water rural distribution systems

System	Customers supplied	Source of supply
Irrigation distribution systems		
Central Goulburn Irrigation Area	Primarily irrigation and domestic and stock to irrigators; also provides bulk supply to seven towns in its area	Waranga Western Channel system, from Stuart Murray Canal, Waranga basin and Waranga Western Channel
Loddon Valley Irrigation Area	Primarily irrigation and domestic and stock to irrigators; also provides bulk supply to four towns in its area and small volumes to the Torrumbarry Irrigation Area	Waranga Western Channel, Loddon River supplement and Torrumbarry Irrigation Area
Murray Valley Irrigation Area	Primarily irrigation and domestic and stock to irrigators; also provides bulk supply to two towns in its area	Murray River via Yarrawonga Main Channel and pumps. Shepparton Irrigation Area via lower Broken Creek
Nyah Irrigation District	Irrigation and domestic and stock to irrigators	Pumped from Murray River
Rochester Irrigation Area	Primarily irrigation and domestic and stock to irrigators; also provides bulk supply to four towns in its area	Waranga Western Channel
Shepparton Irrigation Area	Primarily irrigation and domestic and stock; also provides bulk supply to two towns in its area and to the Murray Valley system via the lower Broken Creek	Goulburn River at Goulburn Weir
Torrumbarry Irrigation Area and Gunbower Creek (excluding Woorinen, Tresco and VMMS)	Primarily irrigation and domestic and stock to irrigators; also provides bulk supply to VMMS, Tresco Irrigation Area, two towns in its area and significant supplies to environmental sites	National Channel and other minor sources from the Murray River; unregulated Loddon flows; small volumes from Pyramid–Boort Irrigation Area
Tresco Irrigation Area	Irrigation and domestic and stock to irrigators	Torrumbarry Irrigation Area
Woorinen Irrigation Area	Irrigation and domestic and stock to irrigators	Pumped from Murray
Other rural distribution systems		
East Loddon domestic and stock	Rural domestic and stock	Waranga Western Channel
Lower Broken Creek	Primarily irrigation and domestic and stock to irrigators; also provides bulk supply to two towns in its area	Shepparton Irrigation Area; minor unregulated inflows from upper Broken Creek

System	Customers supplied	Source of supply
Normanville domestic and stock	Rural domestic and stock; also provides bulk supply to Quambatook urban	Waranga Western Channel
Tungamah domestic and stock	Rural domestic and stock	Shepparton Irrigation Area
Upper Broken Creek	Irrigation diversions	Broken River at Caseys Weir
West Loddon domestic and stock	Rural domestic and stock	Waranga Western Channel

Table 8-8 shows Goulburn–Murray Water's rural distribution systems' water balances.

Table 8-8 Goulburn–Murray Water rural distribution systems' water balances

Distribution system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)					End volume in store (ML)	Distribution system efficiency (%)
			Rural deliveries	Other deliveries	System losses	Passed to other systems	Total outflows		
Irrigation districts									
Central Goulburn Irrigation Area	0	376,329	311,402	0	59,753	5,174	376,329	0	84%
Loddon Valley Irrigation district	0	226,116	184,984	499	39,012	1,621	226,116	0	83%
Murray Valley Irrigation Area	0	334,485	231,195	0	36,996	66,294	334,485	0	89%
Nyah Irrigation Area	0	5,687	5,112	0	575	0	5,687	0	90%
Rochester Irrigation Area	0	187,781	166,712	500	19,440	1,129	187,781	0	90%
Shepparton Irrigation Area	0	224,749	129,208	0	26,144	69,397	224,749	0	88%
Torrumbarry Irrigation Area	13,725	669,840	292,956	34,037	79,109	264,230	670,332	13,233	88%
Tresco Irrigation Area	0	6,182	5,799	0	383	0	6,182	0	94%
Woorinen Irrigation Area	0	13,569	11,823	320	1,426	0	13,569	0	89%
Other rural distribution systems									
East Loddon D&S	0	605	0	464	141	0	605	0	77%
Normanville D&S	54	319	0	173	61	73	307	66	80%
Tungamah D&S	0	502	0	355	147	0	502	0	71%
West Loddon D&S	0	189	0	189	0	0	189	0	100%

The Shepparton Irrigation Area had early take-up of modernisation — lined channels, some closure of spur channels, remotely operated weirs and gates and accurate metering. This is reflected in the system's 88% efficiency.

8.3.4 Coliban Water

Coliban Water provides water and wastewater services to about 146,000 people in 49 cities and towns across central and northern Victoria, the largest of which are Bendigo, Castlemaine, Echuca and Kyneton. Coliban Water also supplies about 1,500 rural licence holders from 500 km of open channels in the Coliban rural water supply system extending from Malmsbury to Bendigo, and to Raywood and surrounding areas.

Coliban Water's service area is within parts of the Campaspe, Loddon, Murray, Goulburn and Avoca basins. It operates two common distribution systems:

- the Goldfields Superpipe incorporating the Eppalock Pipeline, which it jointly operates with Central Highlands Water
- the Coliban Main Channel.

Coliban Water operates nine urban water supply systems including two separate groundwater systems (Elmore and Trentham) and 11 rural subsystems.

8.3.4.1 Goldfields Superpipe

This pipeline transfers water from the Waranga Western Channel and from Lake Eppalock (Campaspe system) for use in the Coliban Water supply system and to supply water to Central Highlands Water's Ballarat system.

Table 8-9 shows the superpipe's water balance.

Table 8-9 Goldfields Superpipe water balance

Goldfields superpipe	Volume (ML)
Volumes in store	
Start volume in store (1 July 2017)	
End volume in store (30 June 2018)	
Change in storage	**-**
Inflows	
From Lake Eppalock - Coliban Water	903
From Lake Eppalock - Central Highlands Water	0
From Waranga Western Channel at Colbinabbin - Coliban Water	41
From Waranga Western Channel at Colbinabbin - Central Highlands Water	0
From Sandhurst Reservoir	0
Unattributed inflow	12
Total inflows	**956**
Outflows	
Direct deliveries to rural customers	**422**
Passed to other systems	
To Emu Valley rural channel sub-system	152
To Axe Creek rural channel sub-system	368
To Specimen Hill rural channel sub-system	14
Transfer to Central Highlands Water (to White Swan Reservoir)	0
To Heathcote urban system (Caledonia Reservoir)	0
To Sandhurst Reservoir-Coliban Water	0
To Spring Gully Reservoir	0
Total passed to other systems	**534**
Losses	**0**
Total outflows	**956**
System efficiency (%)	**100%**

8.3.4.2 Coliban Main Channel

This channel conveys water from the Coliban storages (Upper Coliban, Lauriston and Malmsbury reservoirs) to supply rural subsystems and the Coliban North and Coliban South urban water supply systems.

Table 8-10 shows the water balance for the Coliban Main Channel.

Table 8-10 Coliban Main Channel water balance

Coliban Main Channel	Volume (ML)
Volumes in store	
Start volume in store (1 July 2017)	0
End volume in store (30 June 2018)	0
Change in storage	**-**
Inflows	
From Malmsbury reservoir	25,429
Total inflows	**25,429**
Outflows	
Direct deliveries to customers	**395**
Passed to other systems	
To Coliban North system at Sandhurst Reservoir	16,234
To Poverty Gully rural sub-system	3,157
To Harcourt rural sub-system	965
To Emu Valley rural Sub-system	1,101
To Spring Gully rural sub-system	177
To Specimen Hill rural sub-system	1,671
Total passed to other systems	**23,305**
Losses	
System losses (1)	1729
Total losses	**1,729**
Total outflows	**25,429**
System efficiency (%)	**93%**

Note

(1) System losses are unknown and are represented as the balancing item for this account.

8.3.4.3 Rural distribution systems

Coliban Water's rural distribution system supplies licensed rural customers (including domestic and stock, and irrigation customers) with entitlements of about 15,800 ML in rural areas extending from Castlemaine to Bendigo, and further north to Raywood.

Coliban Water's other distribution systems are rural and are summarised in Table 8-11.

Table 8-11 Coliban Water rural distribution systems

System	Customers supplied	Source of supply
Irrigation distribution systems		
Ascot	Primarily irrigation and domestic & stock irrigators in the Ascot, Ellesmere, Goornong, Huntly and White Hills area	Raw and recycled water
Axe Creek	Primarily irrigation and domestic & stock irrigators in the Axe Creek and Kangaroo area	Raw and recycled water
Cockatoo Hill	Primarily irrigation and domestic & stock irrigators in the Cockatoo Hill, Neilborough, Raywood and Sebastian area	Raw and recycled water
Emu Valley	Primarily irrigation and domestic & stock irrigators in the Abbotts, Emu, Emu Valley, Mannes and Strathfieldsaye area	Raw and recycled water
Harcourt	Primarily irrigation and domestic & stock irrigators in the Harcourt area	Raw and recycled water
Lockwood	Primarily irrigation and domestic & stock irrigators in the Lockwood, Marong and Wilson's Hill area	Raw and recycled water
Poverty Gully	Primarily irrigation and domestic & stock irrigators in the Campbell's Creek and Poverty Gully area	Raw and recycled water
Specimen Hill	Primarily irrigation and domestic & stock irrigators in the Maiden Gully, Myers Flat and Specimen Hill area	Raw and recycled water
Spring Gully Reservoir	No customers supplied in this area	Raw and recycled water
Spring Gully	Primarily irrigation and domestic & stock irrigators in the Diamond Hill and Spring Gully area	Raw and recycled water

Table 8-12 shows Coliban Water's rural distribution systems' water balances.

Table 8-12 Coliban Water rural distribution systems' water balances

Area/system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)				End volume in store (ML)	Distribution system efficiency (%)
			Rural deliveries	System losses	Passed to other systems	Total outflows		
Ascot	0	1,044	792	252	0	1,044	0	76%
Axe Creek	0	368	105	264	0	368	0	28%
Cockatoo Hill	0	622	321	301	0	622	0	52%
Emu Valley	0	1,253	649	604	0	1,253	0	52%
Harcourt	971	965	976	338	0	1,314	622	74%
Lockwood	0	1,007	563	444	0	1,007	0	56%
Poverty Gully	0	3,157	3	244	2,911	3,157	0	92%
Specimen Hill	0	1,685	315	363	1,007	1,685	0	78%
Spring Gully Reservoir	1,044	3,420	0	1,881	1,666	3,547	917	47%
Spring Gully	0	177	91	38	48	177	0	79%

8.3.4.4 Urban distribution systems

Table 8-13 summarises Coliban Water's urban distribution systems.

Table 8-13 Coliban Water urban distribution systems

Area	System / towns supplied	Source of supply	Treatment plant location / comment
Campaspe	Goornong	Campaspe River	Goornong
Coliban Northern	Bendigo system: Bendigo, Axedale, Raywood and Sebastian	Coliban storages (via Main Channel), Lake Eppalock and the Goulburn system (Lake Eildon and Waranga basin via Goldfields Superpipe)	Bendigo and Raywood
	Heathcote system: Heathcote and Tooborac	Lake Eppalock and the Goulburn system (via Goldfields Superpipe)	Heathcote
Coliban Southern	Castlemaine system – McKay Reservoir: Castlemaine, Maldon, Campbells Creek, Chewton, Newstead, Elphinstone, Taradale and Harcourt	Coliban storages (via Coliban Main Channel)	Castlemaine
	Kyneton system: Kyneton, Malmsbury and Tylden	Lauriston Reservoir	Kyneton
Goulburn system	Towns supplied from Pyramid–Boort Irrigation Area: Boort, Dingee, Macorna, Mitiamo, Mysia and Pyramid Hill	Goulburn system (Lake Eildon and Waranga basin)	Boort and Pyramid Hill; no treatment at Dingee, Macorna, Mitiamo and Mysia
	Towns supplied from Rochester Irrigation Area: Lockington and part of Rochester	Goulburn system (Lake Eildon and Waranga basin)	Lockington and Rochester
	Jarklin	Goulburn system – East Loddon pipeline	No treatment (not a drinking water supply)
	Serpentine	Goulburn system – East Loddon pipeline	Serpentine
Loddon system	Bridgewater system: Bridgewater and Inglewood	Loddon River	Bridgewater
	Laanecoorie system: Laanecoorie, Tarnagulla, Bealiba and Dunolly	Loddon River	Laanecoorie
Murray system	Cohuna system: Cohuna, Mead, Gunbower	Murray River – Gunbower Creek	Cohuna
	Echuca	Murray River	Echuca
	Gunbower	Murray River – Taylors Creek	Gunbower
	Leitchville	Murray River – Gunbower Creek and Cohuna irrigation channel	Leitchville
Wimmera system	Borung	Wimmera Mallee Pipeline	No treatment (not a drinking water supply)
	Korong Vale – Wedderburn	Wimmera Mallee Pipeline	Korong Vale
	Wychitella	Wimmera Mallee Pipeline	No treatment (not a drinking water supply)
Supplied by groundwater	Elmore	Lower Campaspe Valley Water Supply Protection Area	Elmore
	Trentham	Spring water and groundwater from Campaspe basin	Trentham

Table 8-14 shows Coliban Water's urban distribution systems' water balances.

Table 8-14 Coliban Water urban distribution systems' water balances

Area/system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)					End volume in store (ML)	Distribution system efficiency (%)
			Urban residential deliveries	Urban non-residential deliveries	System losses (1)	Passed to other systems	Total outflows		
Campaspe									
Goornong	-	65	35	10	20	0	65	-	70%
Coliban Northern									
Bendigo system	1,375	17,254	8,702	3,044	4,703	0	16,449	2,180	71%
Heathcote system	181	400	154	83	162	0	399	181	59%
Coliban Southern									
Castlemaine system – McKay Reservoir (2)	631	3,009	1,207	864	417	0	2,488	1,152	83%
Kyneton system	-	1,041	493	447	101	0	1,041	-	90%
Goulburn system									
Supplied from PH-Boort Irrigation Area (3)	-	428	170	67	191	0	428	-	55%
Supplied from Rochester Irrigation Area (4)	-	797	423	350	24	0	797	-	97%

Area/system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)					End volume in store (ML)	Distribution system efficiency (%)
			Urban residential deliveries	Urban non-residential deliveries	System losses (1)	Passed to other systems	Total outflows		
Jarklin	-	2	1	0	1	0	2	-	50%
Serpentine	-	29	14	3	12	0	29	-	59%
Loddon system									
Bridgewater system	-	267	93	47	127	0	267	-	52%
Laanecoorie system	-	130	78	24	28	0	130	-	78%
Murray system									
Cohuna system	-	924	320	268	336	0	924	-	64%
Echuca	-	3,106	1,699	1,333	74	0	3,106	-	98%
Gunbower	-	66	33	13	20	0	66	-	70%
Leitchville	-	279	46	115	118	0	279	-	58%
Wimmera system									
Borung	-	3	3	0	0	0	3	-	100%
Korong Vale - Wedderburn	-	223	82	33	108	0	223	-	52%
Wychitella	-	3	1	1	1	0	3	-	67%
Supplied by groundwater									
Elmore	-	140	66	28	46	0	140	-	67%
Trentham (5)	81	140	76	21	55	0	152	69	64%

Notes

(1) System losses are the balancing item for all systems.
(2) Castlemaine system consists of Castlemaine, Chewton, Elphinstone, Taradale, Fryerstown, Guildford, Newstead, Campbells Creek, Maldon and Harcourt.
(3) Pyramid-Boort Irrigation Area consists of Macorna town, Pyramid Hill town, Boort town, Mysia town, Mitiamo town and Dingee town.
(4) Rochester Irrigation Area consists of Lockington town and Rochester town (part).
(5) Trentham passed to other systems is spilled down Trent Creek.

8.3.5 Lower Murray Water

Lower Murray Water's area of operation extends along the Murray River from Kerang to the South Australian border, taking in the municipalities of Mildura, Swan Hill and Gannawarra. It provides the region with urban water and wastewater services, and it supplies river-quality water to domestic and stock users as well as irrigation customers. It also operates subsurface irrigation drainage water collection systems.

Lower Murray Water operates four irrigation distribution systems, three other rural distribution systems and 10 urban distribution systems.

Table 8-15 summarises Lower Murray Water's rural distribution systems.

Table 8-15 Lower Murray Water rural distribution systems

System	Customers supplied	Source of supply
Irrigation distribution systems		
First Mildura Irrigation District	Primarily irrigators both in and adjacent to the district, which supplies irrigation and domestic and stock	Murray River at Mildura pumps
Merbein Irrigation District	Primarily irrigators, both in and adjacent to the district, which supplies irrigation and domestic and stock; also passes water to the Wargan–Yelta part of the Cardross–Yelta waterworks district	Murray River at Merbein pumps
Red Cliffs Irrigation District	Primarily irrigators, both in and adjacent to the district, which supplies irrigation and domestic and stock; also supplies environmental water to Cardross basin and passes water to the Cardross part of the Cardross–Yelta waterworks district	Murray River at Red Cliffs pumps
Robinvale Irrigation District	Primarily irrigators, both in and adjacent to the district, which supplies irrigation and domestic and stock customers	Murray River at Robinvale pumps
Other rural distribution systems		
Millewa waterworks district	Primarily piped supply to domestic and stock customers; also supplies three small towns and irrigation water diverted from Lake Cullulleraine	Murray River at Lake Cullulleraine pumps
Cardross–Yelta waterworks district – Wargan–Yelta part only	Domestic and stock customers	Merbein Irrigation District

Table 8-16 shows Lower Murray Water's rural distribution systems' water balances.

Table 8-16 Lower Murray Water rural distribution systems' water balances

Distribution system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)					End volume in store (ML)	Distribution system efficiency (%)
			Rural deliveries	Other deliveries	Losses	Passed to other systems	Total outflows		
Irrigation distribution systems									
First Mildura Irrigation District [1]	0	38,824	35,635	447	2,742	0	38,824	0	89%
Merbein Irrigation District	0	21,074	19,460	0	1,614	0	21,074	0	90%
Red Cliffs Irrigation District	0	33,928	30,172	0	3,756	0	33,928	0	87%
Robinvale Irrigation District	0	19,228	19,228	0	0	0	19,228	0	100%
Other rural distribution systems									
Millewa waterworks district [2]	120	1,127	852	0	207	68	1,127	120	76%
Yelta waterworks district	0	2	2	0	0	0	2	0	100%

Note
(1) Other deliveries of 447 ML are to wetlands for environmental purposes.
(2) For the Millewa waterworks district, the distribution system efficiency includes allowance for evaporation losses from Lake Cullulleraine (off-stream storage).

Table 8-17 summarises Lower Murray Water's urban distribution systems.

Table 8-17 Lower Murray Water urban distribution systems

System / towns supplied	Source of supply	Treatment plant location / comment
Kerang	Murray River, Loddon River, Torrumbarry Irrigation Area	Kerang
Koondrook	Murray River	Koondrook
Mildura system: Mildura (including Cardross, Koorlong and Nicholls Point), Merbein and Irymple	Murray River	Mildura
Millewa system: Werrimull, Meringur and Cullulleraine	Millewa waterworks district	Millewa
Murrabit	Murray River	Murrabit
Mystic Park	Victorian Mid-Murray Storages (Lake Kangaroo)	Raw water supply only (no treatment plant)
Piangil	Murray River	Piangil
Red Cliffs	Murray River	Red Cliffs
Robinvale	Murray River	Robinvale
Swan Hill system: Swan Hill, Lake Boga, Nyah, Nyah West, Woorinen South and Wakool Shire (NSW)	Murray River	Swan Hill

Table 8-18 shows Lower Murray Water's urban distribution systems' water balances.

Table 8-18 Lower Murray Water urban distribution systems' water balances

Distribution system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)				End volume in store (ML)	Distribution system efficiency (%)
			Urban residential deliveries	Urban non-residential deliveries	Losses [1]	Total outflows		
Kerang	6	1,160	750	195	215	1,160	6	81%
Koondrook	3	270	179	18	73	270	3	73%
Mildura system	48	13,727	9,844	2,639	1,244	13,727	48	91%
Millewa system	-	68	64	0	4	68	-	95%
Murrabit	2	34	22	9	3	34	2	90%
Mystic Park	-	16	6	1	9	16	-	43%
Piangil	1	134	46	62	26	134	1	81%
Red Cliffs	7	1,371	731	474	165	1,371	7	88%
Robinvale	5	632	414	161	58	632	5	91%
Swan Hill system	14	4,027	2,807	964	256	4,027	14	94%

8.4 Gippsland region

8.4.1 East Gippsland Water

East Gippsland Water's service area spans 21,000 km^2. It extends east from Lindenow through to the region's capital Bairnsdale, the holiday centres of Paynesville and Lakes Entrance, and on to the Wilderness Coast and Mallacoota near the New South Wales border. The corporation also serves as far north as Dinner Plain in the High Country of the Victorian Alps. Water services are provided to more than 35,000 customers via nine separate water supply systems.

Table 8-19 summarises East Gippsland Water's urban distribution systems.

Table 8-19 East Gippsland Water urban distribution systems

System / towns supplied	Source of supply	Treatment plant location
Bemm River	Bemm River	Bemm River
Buchan	Buchan River	Buchan
Cann River	Cann River	Cann River
Dinner Plain	Groundwater	Dinner Plain
Mallacoota	Betka River and groundwater	Mallacoota
Mitchell system: Bairnsdale, Paynesville, Lindenow, Lindenow South, Eagle Point, Newlands Arm, Raymond Island, Banksia Peninsula, Granite Rock, Wy Yung, Bruthen, Sarsfield, Nicholson, Johnsonville, Swan Reach, Metung, Lakes Entrance, Lake Bunga, Lake Tyers, Lake Tyers Beach and Nowa Nowa	Mitchell River at Glenaladale	Woodglen
Omeo	Butchers Creek	Omeo
Orbost system – Orbost, Newmerella and Marlo	Rocky and Brodribb rivers	Orbost
Swifts Creek	Tambo River	Swifts Creek

Table 8-20 summarises East Gippsland Water's urban distribution systems' water balances.

Table 8-20 East Gippsland Water urban distribution systems' water balances

Area/system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)				End volume in store (ML)	Distribution system efficiency (%)
			Urban residential deliveries	Urban non-residential deliveries	System losses	Total outflows		
Bemm River	5	16	9	7	3	19	3	85%
Buchan	-	23	11	12	0	23	-	100%
Cann River	3	43	15	14	14	43	2	67%
Dinner Plain	-	47	23	16	8	47	-	84%
Mallacoota	53	180	100	48	52	200	33	74%
Mitchell system	1,309	5,108	2,823	1,369	717	4,910	1,507	85%
Omeo	8	61	26	22	13	62	7	79%
Orbost system	57	707	256	366	103	725	39	86%
Swifts Creek	3	29	15	9	4	28	4	84%

8.4.2 Gippsland Water

Gippsland Water services an area of just over 5,000 km^2 in the Latrobe Valley. The area has a population of more than 65,000 people. Major industries include dairy, energy and pulp and paper.

Table 8-21 summarises Gippsland Water's urban distribution systems.

Table 8-21 Gippsland Water urban distribution systems

System / towns supplied	Source of supply	Treatment plant location
Erica–Rawson	Trigger Creek	Rawson
Macalister–Thomson area: Briagolong, Coongulla, Glenmaggie, Heyfield, Boisdale, Maffra and Stratford	Groundwater, Lake Glenmaggie, Thomson River, Macalister River	Heyfield, Maffra, Stratford
Mirboo North	Little Morwell River	Mirboo North
Moe system	Narracan Creek and Tanjil River	Moe
Moondarra Reservoir system: Boolarra, Churchill, Cowwarr, Glengarry, Hazelwood North, Jumbuck, Morwell, Rosedale, Toongabbie, Traralgon, Tyers and Yinnar	Moondarra Reservoir, Blue Rock Reservoir	Morwell
Neerim South–Noojee	Tarago Reservoir, Deep Creek and Loch River	Neerim South
Sale system: Sale and Wurruk	Groundwater	Sale

System / towns supplied	Source of supply	Treatment plant location
Seaspray	Merrimans Creek	Seaspray
Warragul–Drouin system: Buln Buln, Drouin, Nilma, Warragul and Warragul South	Tarago Reservoir	Warragul
Willow Grove	Blue Rock Reservoir	Willow Grove

Table 8-22 shows Gippsland Water's urban distribution systems' water balances.

Table 8-22 Gippsland Water urban distribution systems' water balances

Area/system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)				End volume in store (ML)	Distribution system efficiency (%)
			Urban residential deliveries	Urban non-residential deliveries (1)	System losses	Total outflows		
Erica/Rawson	33	59	38	16	5	59	33	92%
Macalister–Thomson area	39	1,585	820	512	250	1,582	43	84%
Mirboo North	2	181	115	32	34	181	2	81%
Moe system (2)	52	4,038	1,703	1,934	400	4,038	53	90%
Moondarra Reservoir system	708	35,905	4,438	29,995	1,503	35,936	677	96%
Neerim South–Noojee	3	207	135	28	45	207	3	78%
Sale system	18	1,850	1,175	504	169	1,849	18	91%
Seaspray	3	35	22	5	10	36	2	73%
Warragul–Drouin system	80	3,642	2,166	701	770	3,636	85	79%
Willow Grove	0	47	30	2	16	47	0	66%

Notes

(1) 'Urban non-residential' includes non-residential use and includes major industry users in some systems.

(2) Thorpdale was previously listed as its own system but is now included under the Moe system.

8.4.3 Southern Rural Water (Macalister system)

Southern Rural Water is responsible for rural water supplies across the whole of southern Victoria (except for water supplied by Wannon Water to its rural customers) from the Great Dividing Range to the coast, and from the South Australian border to the New South Wales border. The majority of Southern Rural Water's customers are direct diverters from unregulated streams or groundwater, but it also operates three irrigation districts. The largest of these is the Macalister Irrigation District, which is supplied principally from Lake Glenmaggie on the Macalister River and from Cowwarr Weir on the Thomson River. The Werribee and Bacchus Marsh irrigation districts are reported in chapter 8.5.

Southern Rural Water's other distribution systems are rural and are summarised in Table 8-23.

Table 8-23 Southern Rural Water rural distribution systems

System	Customers supplied	Source of supply
Irrigation distribution systems		
Macalister Irrigation District	Primarily irrigation and domestic and stock to irrigators	Macalister and Thomson Rivers

Table 8-24 shows the water balance for the Macalister Irrigation District.

Table 8-24 Southern Rural Water Macalister Irrigation District water balance

Distribution system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)				End volume in store (ML)	Distribution system efficiency (%)
			Rural deliveries	Passed to other systems (2)	System losses	Total outflows		
Macalister Irrigation District	0	211,347	162,654	39,697	8,996	211,347	0	96%

Notes

(1) 'Irrigation deliveries' include supply to domestic and stock customers.

(2) 'Passed to other systems' includes water returned to the Thomson and Macalister rivers (outfalls) as well as deliveries to Gippsland Water urban systems.

8.4.4 South Gippsland Water

South Gippsland Water supplies 21 rural centres in South Gippsland from Wonthaggi in the west to Yarram and Alberton in the east. It operates 10 separate urban distribution systems and covers a total area of about 4,000 km^2.

Table 8-25 summarises South Gippsland Water's urban distribution systems.

Table 8-25 South Gippsland Water urban distribution systems

System / towns supplied	Source of supply	Treatment plant location
Dumbalk	Tarwin River (east branch)	Dumbalk
Fish Creek	Battery Creek	Fish Creek
Foster	Deep Creek / Foster Dam	Foster
Korumburra	Coalition Creek storage network	Korumburra
Leongatha system: Leongatha and Koonwarra	Ruby Creek storage network	Leongatha
Loch system: Loch, Nyora and Poowong	Little Bass River	Poowong
Meeniyan	Tarwin River (west branch)	Meeniyan
Toora system: Toora, Port Franklin, Welshpool and Port Welshpool	Agnes River	Toora
Wonthaggi system: Wonthaggi, Inverloch and Cape Patterson	Lance Creek and Lance Creek Reservoir	Lance Creek
Yarram system: Devon North, Alberton, Yarram and Port Albert	Tarra River	Devon North

Table 8-26 shows South Gippsland Water's urban distribution systems' water balances.

Table 8-26 South Gippsland Water urban distribution systems' water balances

Area/system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)				End volume in store (ML)	Distribution system efficiency (%)
			Urban residential deliveries	Urban non-residential deliveries	System losses	Total outflows		
Dumbalk	-	19	9	7	3	19	-	84%
Fish Creek	-	117	13	45	59	117	-	50%
Foster	-	170	72	57	41	170	-	76%
Korumburra	-	697	250	412	35	697	-	95%
Leongatha system	-	1,542	380	970	192	1,542	-	88%
Loch system	-	266	76	121	69	266	-	74%
Meeniyan	-	69	37	17	15	69	-	78%
Toora system	-	551	64	219	268	551	-	51%
Wonthaggi system	-	1,621	991	393	237	1,621	-	85%
Yarram system	-	453	142	208	103	453	-	77%

8.5 Central region

8.5.1 Westernport Water

Westernport Water supplies towns and adjacent properties on Phillip Island, and on the eastern shore of Western Port from The Gurdies to Dalyston. Water is sourced from:

- Candowie Reservoir, a storage on Tennant Creek in the South Gippsland river basin
- direct diversion from the Bass River
- Corinella Aquifer via three groundwater bores.

Water is treated at Candowie Reservoir and passed to the San Remo storage basin, from which it is delivered via a single, integrated distribution system. A permanent population of about 19,000 people is supplied: the population swells to over 100,000 people in peak holiday periods.

Table 8-27 summarises Westernport Water's distribution system's water balances.

Table 8-27 Westernport Water distribution system's water balance

Westernport Water	Volume (ML)
Volumes in store	
Start volume in store (1 July 2017)	-
End volume in store (30 June 2018)	-
Change in storage	**-**
Inflows	
From Candowie Reservoir	2,059
From Bass River	272
Recycled water	89
Total inflows	**2,420**
Outflows	
Deliveries	
To residential customers	1,271
To non-residential customers	730
Total deliveries	**2,001**
Losses	
System losses	419
Total losses	**419**
Total outflows	**2,420**
System efficiency (%)	**83%**

8.5.2 Melbourne Water

Melbourne Water operates a 'common' or wholesale distribution system for the greater Melbourne metropolitan area as well as for connected regional water authorities. It spans four river basins: Bunyip, Yarra, Maribyrnong and Werribee. Water is harvested from the Bunyip, Yarra, Thomson and Goulburn basins. The distribution system draws from several on-stream storages and includes four significant off-stream storages: the Silvan, Cardinia, Sugarloaf and Greenvale reservoirs.

Melbourne Water supplies the three Melbourne retail water corporations: South East Water, Yarra Valley Water and City West Water. It also supplies the bulk entitlement holders in the Greater Yarra system – Thomson River Pool: City West Water, South East Water, Yarra Valley Water, Barwon Water, South Gippsland Water, Western Water and Westernport Water.

Most of the inflows come from protected catchments in the Yarra, Bunyip and Thomson basins, and minimal treatment (chlorination) is required. However, about 20% comes from unprotected catchments, and this water is fully treated by treatment plants at the Sugarloaf, Tarago and Yan Yean reservoirs.

Table 8-28 summarises Melbourne Water's distribution system's water balance.

Table 8-28 Melbourne Water distribution system's water balance

Melbourne Water	Volume (ML)
Volumes in store (1)	
Start volume in store (1 July 2017)	
Silvan Reservoir	35,157
Cardinia Reservoir	189,355
Sugarloaf Reservoir	67,018
Greenvale Reservoir	22,632
Total start volume	**314,162**
End volume in store (30 June 2018)	
Silvan Reservoir	35,590
Cardinia Reservoir	169,485
Sugarloaf Reservoir	55,573
Greenvale Reservoir	22,946
Total end volume	**283,594**
Change in storage	**(30,568)**
Inflows	
From Yarra basin to Silvan	285,684
From Yarra basin to Sugarloaf	101,385
From Goulburn River to Sugarloaf	0
From Tarago Reservoir	16,851
Rainfall on four main storages	14,514
Unaccounted for inflow	20,210
Total inflows	**438,644**
Outflows	
Passed to other systems	
To South East Water	161,067
To Yarra Valley Water	160,470
To City West Water	114,943
To Western Water	9,945
To Gippsland Water	2,127
To Cardinia Creek from Cardinia	1,825
To Stonyford Creek from Silvan	730
Total passed to other systems	**451,107**
Losses	
Evaporation from four main storages	16,744
System losses	1,361
Total losses	**18,105**
Total outflows	**469,212**
System efficiency	96%

Note
(1) Storage figures do not include service reservoirs and tanks.

Factors contributing to the unaccounted-for inflows include ungauged run-off from the catchments of reservoirs, as well as outflows passed to other systems being more accurately metered than inflows to the distribution system.

8.5.3 South East Water

South East Water is one of Melbourne's three retail water corporations. It obtains treated bulk water from Melbourne Water and operates a single, integrated distribution system covering south-east Melbourne, the Mornington Peninsula and part of South Gippsland.

Table 8-29 shows South East Water's urban distribution system's water balance.

Table 8-29 South East Water urban distribution system's water balance

South East Water	Volume (ML)
Volumes in store	
Start volume in store (1 July 2017)	523
End volume in store (30 June 2018)	522
Change in storage	**(1)**
Inflows	
From Melbourne Water	161,067
Recycled water imported from bulk supplier	2,064
Recycled water imported from local treatment plant	3,921
Unaccounted for inflow	3,826
Total inflows	**170,878**
Outflows	
Deliveries	
To residential customers	105,560
To non-residential customers	38,623
Non-revenue consumptive delivery	6,305
Recycled water used	5,985
Total deliveries	**156,473**
Losses	
System losses	14,406
Total losses	**14,406**
Total outflows	**170,879**
System efficiency (%)	92%

8.5.4 Yarra Valley Water

Yarra Valley Water is one of Melbourne's three retail water corporations. It obtains treated bulk water from Melbourne Water and operates a single, integrated distribution system covering the part of greater Melbourne that is in the Yarra basin, extending to Warburton in the east and Wallan in the north. Table 8-30 shows Yarra Valley Water's urban distribution system's water balance.

Table 8-30 Yarra Valley Water urban distribution system's water balance

Yarra Valley Water	Volume (ML)
Volumes in store	
Start volume in store (1 July 2017)	-
End volume in store (30 June 2018)	-
Change in storage	**-**
Inflows	
From Melbourne Water	160,470
Total inflows	**160,470**
Outflows	
Deliveries	
To residential customers	112,487
To non-residential customers	30,669
Non-revenue consumptive delivery	3,699
Total deliveries	**146,855**
Losses	
System losses (1)	13,615
Total losses	**13,615**
Total outflows	**160,470**
System efficiency	**92%**

8.5.5 City West Water

City West Water is one of Melbourne's three retail water corporations. It obtains treated bulk water from Melbourne Water and operates a single, integrated distribution system covering Melbourne's central business district and its inner and western suburbs.

Table 8-31 shows City West Water's urban distribution system's water balance.

Table 8-31 City West Water urban distribution system's water balance

City West Water	Volume (ML)
Volumes in store	
Start volume in store (1 July 2017)	-
End volume in store (30 June 2018)	-
Change in storages (1)	-
Inflows	
Inflows from Melbourne Water	114,943
Recycled water imported from bulk supplier	260
Unaccounted for inflow	5,209
Total inflows	**120,412**
Outflows	
Deliveries	
To residential customers	59,246
To non-residential customers	45,515
Recycled water used	2,731
Non-revenue consumptive delivery	2,730
Total deliveries	**110,222**
Losses	
System losses	10,190
Total losses	**10,190**
Total outflows	**120,412**
System efficiency	**92%**

Note
(1) The recycled / imported inflows amount represents a bulk purchase from Melbourne Water.

8.5.6 Western Water

Western Water is services a rapidly growing area to the west of and adjacent to Melbourne.

It operates a main, integrated distribution system, with a separate supply to Myrniong. Romsey utilises local water for most of the time, but can be supplemented from the main, integrated system during a drought.

Table 8-32 summarises Western Water's urban distribution systems.

Table 8-32 Western Water urban distribution systems

Area	System / towns supplied	Source of supply	Treatment plant location
Main integrated system	Sunbury, Gisborne, Bacchus Marsh, Diggers Rest, Riddles Creek, Macedon, Melton, Mount Macedon, Romsey, Woodend and Lancefield	Bulk supply from Melbourne Water, Rosslynne Reservoir system, Merrimu Reservoir, Djerriwarrh Reservoir and Kerrie Reservoir, Garden Hut Reservoir and groundwater, Campaspe Reservoir and Campaspe River tributaries, Mount Macedon storages and tributaries *(indirectly supplemented from integrated system in times of drought)*	Melton, Gisborne, Romsey, Lancefield, Woodend
Myrniong	Myrniong	Pykes Creek Reservoir	Myrniong

Table 8-33 shows Western Water's urban distribution systems' water balances.

Table 8-33 Western Water urban distribution systems' water balances

Distribution system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)					End volume in store (ML)	Distribution system efficiency (%)
			Urban residential deliveries	Urban non-residential deliveries	System losses	Passed to other systems	Total outflows		
Main integrated system	2,135	16,023	11,382	2,158	2,737	0	16,277	1,881	83%
Myrniong (1)	-	55	36	7	12	0	55	-	78%

Note
(1) Pykes Creek Reservoir is an on-stream storage and as such the start and end volume in storage is reported in the Werribee surface water basin.

8.5.7 Barwon Water

Barwon Water supplies the greater Geelong area (including the Bellarine Peninsula and towns as far west as Birregurra and Forrest) and the Colac, Aireys Inlet, Lorne and Apollo Bay areas.

Table 8-34 summarises Barwon Water's urban distribution systems.

Table 8-34 Barwon Water urban distribution systems

Area	System / towns supplied	Source of supply	Treatment plant location / comment
Apollo Bay	Apollo Bay, Marengo and Skenes Creek	Diversion weir on the West Barham River in the Otway Ranges	Near Marengo
Colac system	Colac urban, and rural areas and towns including Gellibrand, Pirron Yallock, Irrewarra, Coragulac, Alvie, Beeac and Cressy	Olangolah and West Gellibrand reservoirs, which are fed by streams in the Otway Ranges	Colac
Geelong–Bellarine	Greater Geelong: Geelong, Aireys Inlet, Anakie, Avalon, Balliang, Bamganie, Bannockburn, Batesford, Birregurra, Fairhaven, Fyansford, Gheringhap, Inverleigh, Leopold, Lethbridge, Little River, Marshall, Maude, Meredith, Modewarre, Moorabool, Moriac, Mount Moriac, Murgheboluc, She Oaks, Shelford, Staughton Vale, Sutherlands Creek, Teesdale, Thompson, Winchelsea and Wurdiboluc Bellarine Peninsula: Barwon Heads, Bellarine, Breamlea, Clifton Springs, Curlewis, Drysdale, Indented Head, Mannerim, Marcus Hill, Ocean Grove, Point Lonsdale, Portarlington, Queenscliff, St Leonards, Swan Bay and Wallington	Barwon River system – West Barwon Reservoir on the West Barwon River	Wurdee Boluc
		Moorabool River system – various streams in the Moorabool basin	She Oaks
		Barwon Downs borefield – Barwon Downs Aquifer	At bores
		Anglesea borefield – Lower Eastern View formation	At bores
Lorne	Lorne	Allen Reservoir on the St George River, west of Lorne	Lorne

Table 8-35 shows Barwon Water's urban distribution systems' water balances.

Table 8-35 Barwon Water urban distribution systems' water balances

Distribution system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)				End volume in store (ML)	Distribution system efficiency (%)
			Deliveries		System losses	Total outflows		
			To urban residential	To urban other				
Apollo Bay	357	394	202	121	137	460	291	70%
Colac system	645	3,636	1,427	1,348	892	3,667	614	76%
Geelong/Bellarine	30,827	35,559	21,878	8,185	11,115	41,178	25,207	73%
Lorne	-	463	230	94	139	463	-	70%

8.5.8 Central Highlands Water

Central Highlands Water supplies water to the greater Ballarat region and to numerous other localities from Ballan in the east to Landsborough and Navarre in the north-west and Rokewood in the south. Supply and distribution systems spread across seven river basins, north and south of the Great Dividing Range.

Table 8-36 summarises Central Highlands Water's urban distribution systems.

Table 8-36 Central Highlands Water urban distribution systems

System / towns supplied	Source of supply	Treatment plant location
Amphitheatre	Reservoir on Forest Creek	None (non-potable supply)
Avoca	Sugarloaf Reservoir and Bung Bong bore	Avoca
Beaufort and Raglan	Musical Gully Reservoir	Beaufort Supply to Raglan is untreated
Blackwood and Barry's Reef	Long Gully Creek	UV disinfection at Blackwood
Clunes	Groundwater	Clunes
Daylesford system: Daylesford, Hepburn and Hepburn Springs	Wombat Creek, Kangaroo Creek, Hepburn Reservoir and Coomoora Bore	Daylesford
Dean	Groundwater	Chlorine disinfection
Forest Hill system: Allendale, Newlyn, Smeaton, Kingston, Springmount, Broomfield and homes in rural areas	Groundwater	Hardness removed and disinfected; treatment plant is adjacent to the bores
Greater Ballarat system: Alfredton, Ballan, Ballarat, Black Hill, Brown Hill, Bungaree, Buninyong, Corindhap, Creswick, Golden Point, Gordon, Linton, Mt Clear, Scarsdale, Smythesdale, Snake Valley, Skipton and Wallace	White Swan Reservoir, Lal Lal Reservoir, Cosgrave Reservoir, Newlyn Reservoir, Ballarat West groundwater bores and the Goldfields Superpipe	Bendigo Water filtration plants at White Swan and Lal Lal reservoirs
Landsborough and Navarre	Landsborough Reservoir and Groundwater	None (non-potable supply)

System / towns supplied	Source of supply	Treatment plant location
Learmonth	Groundwater	High-quality supply, little treatment is required
Lexton	Lexton Reservoir and groundwater	Lexton Reservoir
Maryborough and district: Adelaide Lead, Alma/Moonlight, Betley, Crisbrook, Craigie, Daisy Hill, Havelock, Majorca, Maryborough, Redborough, Simson/Bet Bet, Talbot and Timor/Bowenvale.	Tullaroop Reservoir, Evansford/Talbot reservoirs and groundwater	Maryborough
Redbank	Redbank Reservoir and groundwater	None (non-potable supply)
Waubra	Groundwater	Waubra

Table 8-37 shows Central Highlands Water's urban distribution systems' water balances. All Central Highlands Water reservoirs are on-stream and hence not included in water balance calculations. Also, White Swan Reservoir is treated in the basin chapters of the accounts as an on-stream storage and thus is not covered here. The headworks system — the channels connecting Moorabool Reservoir to White Swan — is also not covered in this account.

Table 8-37 Central Highlands Water urban distribution systems' water balances

Distribution system	Start volume in store (ML)	Total inflows (ML) (1)	Outflows (ML)				End volume in store (ML)	Distribution system efficiency (%)
			Urban residential deliveries	Urban non-residential deliveries	System losses	Total outflows		
Amphitheatre	-	21	19	0	1	21	-	94%
Avoca	-	218	84	28	106	218	-	51%
Beaufort and Raglan	-	214	106	32	76	214	-	65%
Blackwood and Barry's Reef	-	50	29	6	16	50	-	68%
Clunes	-	221	141	34	45	221	-	79%
Daylesford system	-	654	391	163	100	654	-	85%
Dean	-	16	4	2	10	16	-	35%
Forest Hill system	-	162	107	21	34	162	-	79%
Greater Ballarat system	-	14,348	8,194	3,756	2,397	14,348	-	83%
Landsborough and Navarre	-	37	15	6	16	37	-	58%
Learmonth	-	52	26	18	7	52	-	86%
Lexton	-	25	14	4	6	25	-	74%
Maryborough and district	-	1,592	885	339	368	1,592	-	77%
Redbank	-	4	3	0	1	4	-	77%
Waubra	-	40	21	6	13	40	-	68%

Note

(1) Total inflows represents the flows measured into the distribution system: generally, this represents the volume leaving the treatment plant.

8.5.9 Southern Rural Water (Werribee and Bacchus Marsh systems)

Southern Rural Water operates the Werribee and Bacchus Marsh irrigation districts. Both are in the Werribee basin and are supplied from the Werribee River and its tributaries. The Werribee Irrigation District is also supplied with recycled water from Melbourne Water's Western Treatment Plant, which is not shown in the table.

Southern Rural Water's other distribution systems are rural and are summarised in Table 8-38.

Table 8-38 Southern Rural Water rural distribution systems

System	Customers supplied	Source of supply
Irrigation distribution systems		
Bacchus Marsh Irrigation District	Primarily irrigation and domestic and stock irrigators	Werribee River and Bacchus Marsh urban system
Werribee Irrigation District	Primarily irrigation and domestic and stock irrigators	Werribee River and Melbourne Water's Western Treatment Plant

Table 8-39 shows Southern Rural Water's Werribee and Bacchus Marsh irrigation districts' water balances.

Table 8-39 Southern Rural Water Werribee and Bacchus Marsh irrigation districts' water balances

Distribution system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)				End volume in store (ML)	Distribution system efficiency (%)
			Rural deliveries	Passed to other systems (1)	System losses	Total outflows		
Bacchus Marsh Irrigation District	10	2,658	2,016	57	584	2,658	10	78%
Werribee Irrigation District	130	16,364	10,221	405	5,739	16,364	130	65%

Note

(1) 'Passed to other systems' represent outfalls from the systems. The Bacchus Marsh Irrigation District returns into the Lerderderg River, the Werribee Irrigation District returns to the bay or a lower estuary.

8.6 Western region

8.6.1 Wannon Water

Wannon Water's region extends over 24,500 km^2 from the South Australian border in the west, to Balmoral in the north, to Lismore in the east and to the lower Gellibrand River catchment on the south coast. The City of Warrnambool, Corangamite Shire, Glenelg Shire, Moyne Shire and Southern Grampians Shire local government areas are all within its service area.

Most of Wannon Water's distribution systems supply both towns and rural customers and are shown as consolidated systems. Table 8-40 summarises Wannon Water's combined distribution systems.

Table 8-40 Wannon Water combined distribution systems

Area	System / towns supplied	Source of supply	Treatment plant location
Balmoral	Balmoral	Rocklands Reservoir	Balmoral
Caramut	Caramut	Groundwater	Caramut
Casterton system	Casterton, Coleraine, Sandford, Merino and Tullich pipeline and Coleraine pipeline rural customers	Groundwater	Casterton
Darlington	Darlington	Groundwater	None (non-potable supply)
Dartmoor	Dartmoor	Groundwater	Dartmoor
Glenthompson system	Glenthompson and Willarura pipeline rural customers	Glenthompson and Railway reservoirs and Willaura pipeline	Glenthompson
Grampians system (excl. Balmoral)	Hamilton, Cavendish, Dunkeld Tarrington and Hamilton pipeline customers	Glenelg River tributaries, Waterfall Creek, Rocklands Reservoir and groundwater	Hamilton, Cavendish and Dunkeld
Heywood	Heywood	Groundwater	Heywood
Konongwootong	Konongwootong (rural customers only)	Konongwootong Reservoir	None (non-potable supply)
Macarthur	Macarthur	Groundwater	Macarthur
Otway system	Warrnambool, Simpson, Cobden, Camperdown, Noorat, Glenormiston, Lismore, Derrinallum, Terang, Mortlake, Purnim, Allansford, Koroit and North Otway pipeline rural customers	Arkins Creek catchment, Gellibrand River, groundwater and roofwater harvest (Brierly)	Warrnambool, Simpson, Cobden, Camperdown, Terang and Purnim
Penshurst	Penshurst	Groundwater	Penshurst
Port Campbell system	Port Campbell, Peterborough and Timboon	Groundwater	Port Campbell
Port Fairy	Port Fairy	Groundwater	Port Fairy
Portland	Portland	Groundwater	Portland

Table 8-41 shows Wannon Water's combined distribution systems' water balances. The volume of water in storage and total inflows volumes are calculated at the system level, hence data for these items is not available for individual towns. Similarly, reticulation system loss volumes are not available for individual towns for the Otway system and are presented at the system level.

Table 8-41 Wannon Water combined distribution systems' water balances

Distribution system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)						End volume in store (ML)	Distribution system efficiency (%)
			Urban residential deliveries	Urban other	Pipeline	System losses	Passed to other systems	Total outflows		
Balmoral	-	47	13	18	11	5	0	47	-	89%
Caramut	-	25	7	9	2	7	0	25	-	72%
Casterton system	-	384	179	116	4	85	0	384	-	78%
Darlington	-	4	2	1	0	1	0	4	-	79%
Dartmoor	-	24	14	6	0	4	0	24	-	84%
Glenthompson system	74	45	9	4	19	26	0	58	61	56%
Grampians system (excl Balmoral)	2,058	1,495	802	315	20	390	0	1,527	2,026	74%
Heywood	-	159	93	32	0	34	0	159	-	79%
Konongwootong	-	67	0	0	32	34	0	67	-	49%
Macarthur	-	27	14	4	0	10	0	27	-	63%
Otway system	2,016	9,250	3,008	4,596	496	1,114	0	9,214	2,052	88%
Penshurst	-	65	37	14	0	14	0	65	-	79%
Port Campbell system	-	329	113	119	52	46	0	329	-	86%
Port Fairy	-	614	279	283	0	52	0	614	-	92%
Portland	-	1,727	708	645	0	375	0	1,727	-	78%

Note

In previous Victorian Water Accounts, Wannon Water combined water balances contained eight distribution systems. This year we have changed our distribution system reporting to be consistent with Wannon Water's distribution systems. The same area has been reported however the split is different from previous years.

8.6.2 Grampians Wimmera Mallee Water

Grampians Wimmera Mallee Water supplies water to urban and rural customers via the extensive Wimmera Mallee Pipeline system. It supplies the larger urban areas in the south — Ararat, Stawell and Horsham — via separate distribution systems. It supplies many towns from groundwater.

Grampians Wimmera Mallee Water services a large area – about 25% of Victoria – in the north-west of the state. It sources most of its water from a complex system of storages in the Grampians, but the northern part of the rural pipeline system is supplied from the Murray.

The rural pipeline system has been divided for reporting purposes into seven distribution systems, each of which supplies several towns. These are presented for simplicity as consolidated reports for the urban and rural systems.

Table 8-42 summarises Grampians Wimmera Mallee Water's combined distribution systems.

Table 8-42 Grampians Wimmera Mallee Water combined rural and urban distribution systems

Area	System / towns supplied	Source of supply	Treatment plant location / comment
Northern Mallee Pipeline	Supplies rural customers around Ouyen and urban customers in Chillingollah, Chinkapook, Ouyen, Manangatang, Nandaly, Nullawil, Patchewollock, Speed, Tempy, Underbool, Waitchie and Walpeup	Murray River at Wemen, Piangil, Nyah and Swan Hill	Treatment plants at Ouyen and Underbool Chlorinators at Manangatang, Nullawil and Walpeup; untreated at Chillingollah, Chinkapook, Nandaly, Patchewollock, Speed, Tempy and Waitchie
Wimmera Mallee Pipeline supply systems 1 and 7	Supplies rural customers in the south-west Wimmera and urban customers in Pimpinio, Dimboola, Antwerp, Yaapeet, Jeparit, Rainbow and Tarranyurk	Wimmera headworks at Lake Bellfield and/or Taylors Lake	Treatment plants at Dimboola and Rainbow Untreated at Pimpinio, Antwerp, Yaapeet, Jeparit and Tarranyurk
Wimmera Mallee Pipeline Supply System 2	Supplies rural customers as far north as Lascelles and urban customers in Jung, Murtoa, Warracknabeal, Brim, Beulah, Hopetoun, Woomelang and Lascelles	Wimmera headworks at Lake Bellfield and/or Taylors Lake	Treatment plants at Warracknabeal, Murtoa and Hopetoun Chlorinators at Jung, Brim, Beulah and Woomelang Untreated at Lascelles
Wimmera Mallee Pipeline Supply System 3	Supplies rural customers to the north-east of Horsham and urban customers in Birchip, Glenorchy, Marnoo, Minyip, Rupanyup and Watchem	Wimmera headworks at Lake Bellfield and/or Taylors Lake	Treatment plants at Birchip and Rupanyup Chlorinator at Minyip Untreated at Glenorchy, Marnoo and Watchem
Wimmera Mallee Pipeline Supply System 4	Supplies rural customers to the north-east of Horsham and urban customers in Charlton, Donald, St Arnaud and Wycheproof	Wimmera headworks at Lake Bellfield and/or Taylors Lake	Treatment plants at Charlton and St Arnaud Chlorinator at Donald and Wycheproof
Wimmera Mallee Pipeline Supply System 5	Supplies rural customers to the south and west of Swan Hill and urban customers in Berriwillock, Sea Lake, Culgoa, Lalbert and Ultima	Murray River at Swan Hill	Chlorinators at Sea Lake, Lalbert and Ultima Untreated at Berriwillock and Culgoa
Wimmera Mallee Pipeline Supply System 6	Supplies rural customers to the west and south of Horsham	Wimmera headworks on Moora Channel supplied from either Lake Wartook or Moora Moora Reservoir into the Brimpaen storages	Raw water supply only Untreated at Clear Lake and Noradjuha

Table 8-43 Grampians Wimmera Mallee Water combined distribution systems' water balances

Distribution system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)					End volume in store (ML)	Distribution system efficiency (%)
			Urban residential deliveries	Urban non-residential deliveries	Rural deliveries	System losses	Total outflows		
Northern Mallee Pipeline	-	3,682	509	253	1,962	958	3,682	0	74%
Wimmera Mallee Pipeline Supply System 1	-	1,781	559	320	543	358	1,781	0	80%
Wimmera Mallee Pipeline Supply System 2	-	2,981	659	174	1,547	602	2,981	-	80%
Wimmera Mallee Pipeline Supply System 3	-	2,127	127	26	1,545	429	2,127	-	80%
Wimmera Mallee Pipeline Supply System 4	-	3,081	657	307	1,495	622	3,081	-	80%
Wimmera Mallee Pipeline Supply System 5	-	343	42	19	265	17	343	-	95%
Wimmera Mallee Pipeline Supply System 6	120	416	1	0	493	41	536	-	92%
Wimmera Mallee Pipeline Supply System 7	-	318	83	121	17	97	318	-	70%

Grampians Wimmera Mallee Water also operates 18 urban-only distribution systems, summarised in Table 8-44.

Table 8-44 Grampians Wimmera Mallee Water urban distribution systems

System	Source of supply	Treatment plant location / comment
Surface water systems		
Ararat system: Ararat and Great Western	Mt Cole Reservoir and Lake Fyans	Ararat
Buangor	Mcleod's Creek weir	Untreated
East Grampians system: Lake Bolac, Moyston, Wickliffe and Willaura	Mt William, Stoney and Masons creeks and groundwater	Willaura serves Willaura and Lake Bolac; untreated at Moyston and Wickliffe
Elmhurst	Hickman's Creek weir	Untreated
Horsham system: Horsham, Haven and Natimuk	McKenzie River, Rocklands Channel and groundwater	Horsham
Quambatook	Normanville pipeline	Chlorinator at Quambatook
Stawell	Lake Fyans and Fyans Creek	Stawell
Groundwater systems		
Apsley	West Wimmera	Untreated
Cowangie	Murrayville	Untreated
Edenhope	West Wimmera	Edenhope
Goroke	West Wimmera	Untreated
Harrow	West Wimmera	Untreated
Kaniva	West Wimmera	Untreated
Kiata	West Wimmera	Untreated
Lillimur	West Wimmera	Untreated
Miram	Murrayville	Untreated
Murrayville	West Wimmera	Untreated
Serviceton	West Wimmera	Untreated
Streatham and Westmere	Outside management area groundwater bores	Untreated

Table 8-45 Grampians Wimmera Mallee Water urban distribution systems' water balances

Distribution system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)					End volume in store (ML)	Distribution system efficiency (%)
			Urban residential deliveries	Urban non-residential deliveries	System losses	Passed to other systems	Total outflows		
Surface water systems									
Ararat system	249	1,488	715	678	178	0	1,570	166	89%
Buangor	26	9	10	1	()	0	11	24	100%
East Grampians system	120	343	121	88	113	46	368	95	69%
Elmhurst	30	8	14	4	1	0	19	18	94%
Horsham system	-	2,990	1,889	497	604	0	2,990	-	80%
Quambatook	-	73	33	20	20	0	73	-	72%
Stawell	405	1,514	627	402	489	0	1,517	402	68%
Groundwater systems									
Apsley	-	27	16	7	4	0	27	-	85%
Cowangie	-	7	1	0	6	0	7	-	16%
Edenhope	-	130	73	25	32	0	130	-	75%
Goroke	-	52	29	4	18	0	52	-	65%
Harrow	-	46	20	4	22	0	46	-	52%
Kaniva	-	197	129	40	27	0	197	-	86%
Kiata	-	5	3	0	2	0	5	-	69%
Lillimur	-	7	6	0	1	0	7	-	87%
Miram	-	1	1	0	0	0	1	-	100%
Murrayville	-	123	63	53	7	0	123	-	94%
Serviceton	-	7	3	1	3	0	7	-	55%
Streatham & Westmere	1	33	7	5	14	0	26	8	46%

Abbreviations

AWRC	Australian Water Resources Council
BMFEWA	Barmah-Millewa Forest Environmental Water Allocation
CEWH	Commonwealth Environmental Water Holder
CMA	Catchment management authority
DELWP	Department of Environment, Land, Water and Planning (Victorian Government)
EPA	Environment Protection Authority Victoria
FFG Act	*Flora and Fauna Guarantee Act 1988*
GL	Gigalitre
GMA	Groundwater management area
GMU	Groundwater management unit
LTA	Long-term average
LTWRA	Long-term water resource assessment
MDBA	Murray–Darling Basin Authority
NVIRP	Northern Victoria Irrigation Renewal Project
ML	Megalitre
PCV	Permissible consumptive volume
PWSR	Permanent water saving rules
REALM	Resource allocation model
RMIF	River Murray Increased Flows
SFMP	Streamflow management plan
STEDI	Spatial Tool for Estimating Dam Impacts
SWS	Sustainable water strategy
VDP	Victorian Desalination Project
VEWH	Victorian Environmental Water Holder
VMMS	Victorian Mid-Murray Storages
WSPA	Water supply protection area
WWC	Waranga Western Channel

Glossary

Allocation: The assignment of water within a given water year against a water entitlement held by a person or authority. See also 'Seasonal allocation'.

Aquifer: A layer of underground sediments that holds groundwater and allows water to flow through it.

Aquitard: An underground layer of clay, silt or rock with low permeability which restricts the movement of groundwater between aquifers.

Basin (river basin): The area of land into which a river and its tributaries drain. In the Victorian water accounts, river basins are consistent with those defined by the Australian Water Resources Council (AWRC). The exception is the Murray basin that, for the purposes of this report, includes the Upper Murray basin as defined by the AWRC as well as areas in Victoria supplied from the Murray River downstream of Lake Hume. See also 'river basin'.

Bulk entitlement: The right to water held by water and other authorities defined in the *Water Act 1989*. A bulk entitlement defines the amount of water from a river or storage to which an authority is entitled, and it may include the rate at which it may be taken and the reliability of the entitlement.

Bulk entitlement conversion order: The statutory instrument used to issue a bulk entitlement under the provisions in the *Water Act 1989*.

Consumptive entitlement: A water entitlement that permits the holder to use the water taken under the entitlement for the purposes of consumption.

Cap: A limit placed on the amount of water that can be taken from a system within a given timeframe.

Carryover: Provides the right to take unused allocations at the end of one season into the subsequent season. Carryover is available under rules to the holders of permanent entitlements, including water shares, supplies by agreement and specified bulk and environmental entitlements, in the regulated water systems of northern Victoria.

Catchment: An area of land where run-off from rainfall goes into one river system.

Catchment management authority (CMA): A statutory body established under the *Catchment and Land Protection Act 1994*. CMAs have responsibilities under both the Catchment and Land Protection Act and the *Water Act 1989* for river health, for regional and catchment planning and coordination, and for managing waterways, floodplains, salinity and water quality.

Declared system: A water system that has been declared in accordance with section 6A of the *Water Act 1989*. Water rights and take and use licences in declared water systems have been converted into unbundled entitlements.

Distribution system: The infrastructure constructed, maintained and owned by a water corporation that is used to distribute water from its source to a user.

Entitlement: See 'Water entitlement'.

Environment: Surroundings in which an organisation operates including air, water, land, natural resources, flora, fauna, humans and their interdependence.

Environmental (bulk) entitlement: A water entitlement held by the Minister for Water that permits the use of water in a river or storage for a purpose that benefits the environment.

Environmental flow: The streamflow required to maintain appropriate environmental conditions in a waterway.

Evaporation: The process by which water changes from a liquid to a gas or vapour.

Evapotranspiration: The sum of transpiration by plants, evaporation from soil and open water surfaces, and evaporation from the wet surfaces of plants soon after rainfall.

Floodplain: Land adjacent to rivers which is subject to overflow during flood events. Floodplains are often valuable for their ecological assets.

Groundwater: The reserve of water that is located beneath the earth's surface in pores and crevices of rocks and soil. These areas vary in size and volume throughout Victoria and are known as aquifers.

Groundwater management unit (GMU): Groundwater in Victoria is managed through GMUs. A GMU may be classified as either a GMA or a WSPA.

Groundwater management area (GMA): A discrete area where groundwater resources of a suitable quality for irrigation, commercial or domestic and stock use are available or expected to be available. The area may have a management plan approved by the relevant rural water corporation.

Heritage river: A river protected in Victoria for its special features under the *Heritage Rivers Act 1992*.

Irrigation district: An area declared under the *Water Act 1989* that is supplied with water by channels and pipelines used mainly for irrigation purposes.

Long-term average annual rainfall (expressed as a percentage): The amount of rainfall across the geographical spread of an area, which is averaged over a grid of about 25 by 25 km.

Living Murray: A program to improve the health of the Murray River, established by the Murray–Darling Basin Ministerial Council in 2002 and funded by the New South Wales, Victorian, South Australian, Australian Capital Territory and Australian governments.

Megalitre: One million litres.

Millennium Drought: The most severe drought in Victoria's recorded history, spanning from late 1996 to 2010.

Murray–Darling basin cap: The climatically adjusted limit on surface water diversions in the Murray–Darling Basin, agreed by a ministerial council under the Murray–Darling Basin Agreement.

Non-potable: Water not suitable for drinking

Order (ordering of water): The advance notification given by an entitlement holder to a storage operator to enable the storage operator to regulate water flows so that all entitlement holders' needs can be met at a particular time.

Passing flow requirements: The flows that a water authority must pass at its weirs or reservoirs before it can take water for other uses. Passing flow requirements are specified as obligations in bulk entitlements, and entitlement holders must report on their compliance with these requirements.

Percent full: The volume of water in storage as a percentage of the accessible storage capacity. Note that the percentage full may exceed 100% (for example, due to floods).

Permissible consumptive volume (PCV): The total amount of water that can be taken in a GMU under a ministerial declaration.

Qualification of rights: The Minister for Water has the power (under section 33AAA of the *Water Act 1989*) to qualify rights to water to maintain essential supplies to towns and rural communities. The Minister may declare a temporary qualification of rights where a water shortage exists in an area or water system. Where the water shortage is due to a long-term change to water availability, a permanent qualification of rights may be declared but only following a long-term water resources assessment which finds the long-term water availability will have a disproportionate effect on water allocated for consumptive purposes or the environment.

Ramsar Convention: An international treaty that aims to conserve wetlands which have been listed for their international significance, to ensure they are managed wisely. It was agreed in Ramsar, Iran, in 1971.

REALM model: A computer-based water supply system model used by DELWP to aid the allocation of Victoria's water resources. It is an abbreviation of REsource ALlocation Model.

Recycled water: Water (derived from sewerage systems or industry processes) that is treated to a standard appropriate for its intended end use.

Representative river: A river that can be used to represent the major river classes that once occurred naturally across Victoria. A river also needs to be in good condition to be representative. A list of the suggested representative rivers is in the 2002 *Victorian River Health Strategy*.

Regulated river: A river containing structures (such as dams or major diversion weirs) which control the flow of water in the river for licensed diverters or users in an irrigation district.

Reticulation system: The network of pipelines used to deliver water to end users.

Riparian: Situated alongside a river or stream.

River: Large stream of water flowing to the sea, a lake, a marsh or another river.

River basin: The land into which a river and its tributaries drain. See also 'Basin'.

Seasonal allocation: An entitlement holder's share of the water available for a season, determined by a water corporation and expressed as a percentage of the entitlement holder's water share. It is sometimes shortened to 'allocation'.

Sewage: The waterborne wastes of a community.

Small catchment dam: A dam that is filled from its own catchment and is not located on a waterway. This includes small catchment dams used for domestic and stock purposes which are not required to be licensed. It also includes dams used for commercial purposes and irrigation which are now required to be registered (under the *Water Act 1989*). Not all small catchment dams are registered as yet.

Snowy Water Inquiry: The Snowy Water Inquiry was established under *Snowy Hydro Corporatisation Act 1997* (New South Wales). This inquiry identified and analysed options to mitigate the impact of the Snowy Scheme on environmental flows.

South Australia–Victoria Designated Area: The area extending 20 km either side of the border between South Australia and Victoria, as set out under the *Groundwater (Border Agreement) Act 1985*, established for the cooperative management and equitable sharing of groundwater resources between the states.

Spill: An uncontrolled flow of water past a reservoir or a weir.

Stream: A body of water flowing in a bed, river or brook.

Streamflow management plan: A statutory management plan prepared for a WSPA to manage the surface water resources of the area.

Take and use licence: A fixed-term entitlement to take and use water from a waterway, catchment dam, spring, soak or aquifer. Each licence is subject to conditions set by the Minister for Water and specified on the licence.

Terminal lakes: Lakes which form the end point of all surface water flow within a basin.

Transpiration: The process by which water that is absorbed by plants, usually through the roots, is evaporated from the plant surface into the atmosphere.

Unincorporated area: An area of Victoria which contains substantial and often unquantified groundwater of varying yield and quality that has not been designated as either a GMA or a WSPA.

Unregulated river: A river that does not contain any dams or major diversion weirs which control the flow of water in the river.

Use (water use): The water use data presented in this edition of the Victorian water accounts is reported as the volume of water diverted from a stream or groundwater bore. It is not the same as 'use' by the end consumer of the water.

***Victorian Water Register*:** Provides water users with essential information about water entitlements, seasonal allocations, trade and transfers. The water register is the authoritative record of water entitlements, and it facilitates the transactions that underpin Victoria's water markets.

Wastewater: The volume of sewage that enters a dedicated treatment plant.

Water corporations: Government organisations charged with supplying water to urban and rural water users. They administer the diversion of water from waterways and the extraction of groundwater. They were formerly known as water authorities.

Water balance: A statement of the water flows in a given area and time period, in which the sum of the outflows from the area equals the sum of the inflows less the water accumulated in the area.

Water entitlement: The volume of water authorised to be taken and used by the holder. Water entitlements include bulk entitlements, environmental entitlements, water rights, surface water and groundwater licences.

Water leaving the basin: The volume of water that is calculated to flow out of the basin. This amount is typically derived from both gauged streamflow information and calculated information.

Water right: A water entitlement held by an irrigator in an irrigation district.

Water share: A legally recognised, secure share of the water available to be taken from a declared water system. Water shares were created as part of the unbundling reforms. Water shares may be high-reliability or low-reliability, and they are specified as a maximum volume of seasonal allocation that may be made against that share.

Water supply protection area (WSPA): An area declared under section 27 of the *Water Act 1989* to protect the area's groundwater or surface water resources for equitable management and long-term sustainability. A WSPA is subject to a statutory management plan approved by the Minister for Water.

Waterway: The *Water Act 1989* defines a waterway as a river, creek, stream, watercourse and a natural channel where water regularly flows, whether or not the flow is continuous.

Wetlands: Inland, standing, shallow bodies of water that may be permanent or temporary, and fresh or saline.

Yield: The quantity of water that a storage or aquifer produces.

Appendix A: Estimated evapotranspiration

Evapotranspiration is modelled as the sum of transpiration by plants, evaporation from soil and open water surfaces, and evaporation from the wet surfaces of plants soon after rainfall. This appendix presents modelled basin estimates of evapotranspiration.

Evapotranspiration amounts vary considerably across Victoria depending on a range of factors, including water availability. Averaged across Victoria as a whole, evapotranspiration in 2017–18 was estimated to be 507 mm, which is about 17% below the long-term average from 1961 to 1990.

Modelled estimates of basin evapotranspiration are presented in Figure A-1. Evapotranspiration is presented in terms of millimetres per unit area to allow for direct comparison between basins of different sizes.

Figure A-1 shows that annual evapotranspiration was lower in 2017–18 than average conditions for all Victorian basins. However, evapotranspiration rates resembled the mean most closely in the regions which recorded the highest rainfall as a percentage of long-term average rainfall. These regions included the Kiewa basin in the north-east and the Hopkins, Portland, Glenelg and Millicent Coast basins in the south-west. Conversely, the south-east experienced lower evapotranspiration than average, due to lower than average rainfall.

Figure A-1 Modelled evapotranspiration per unit area (mm), 2017–18

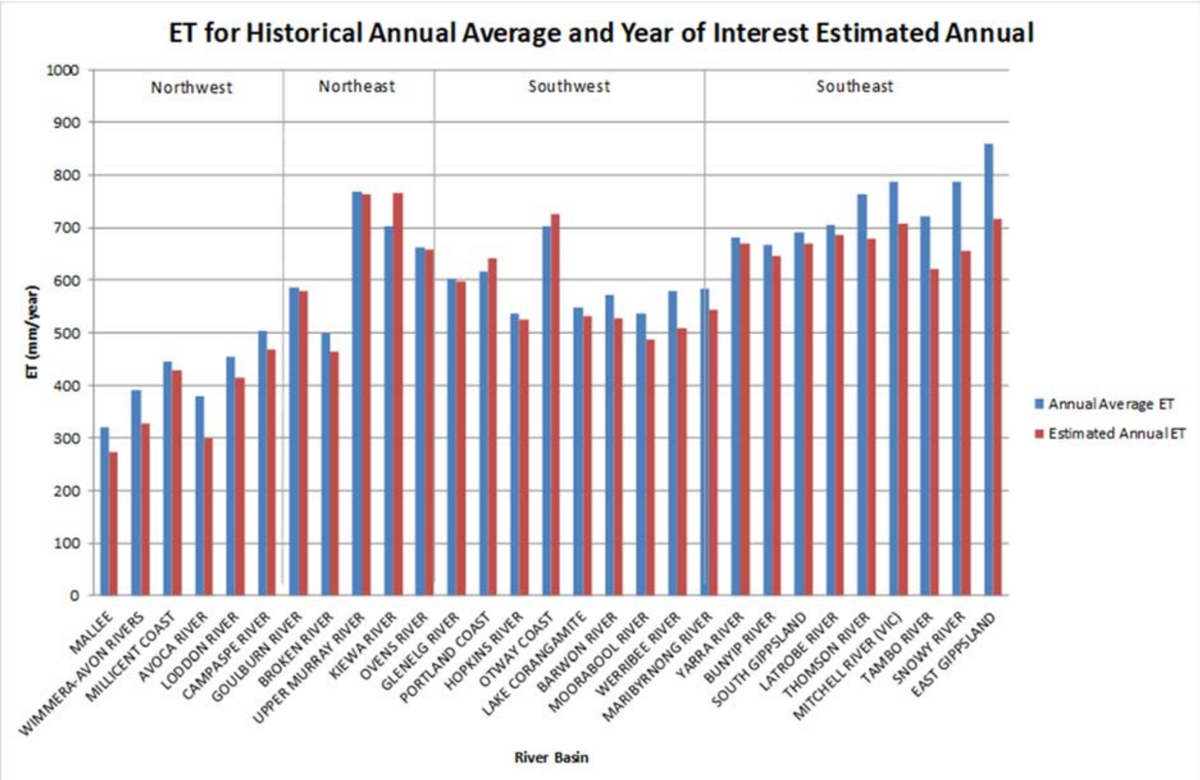
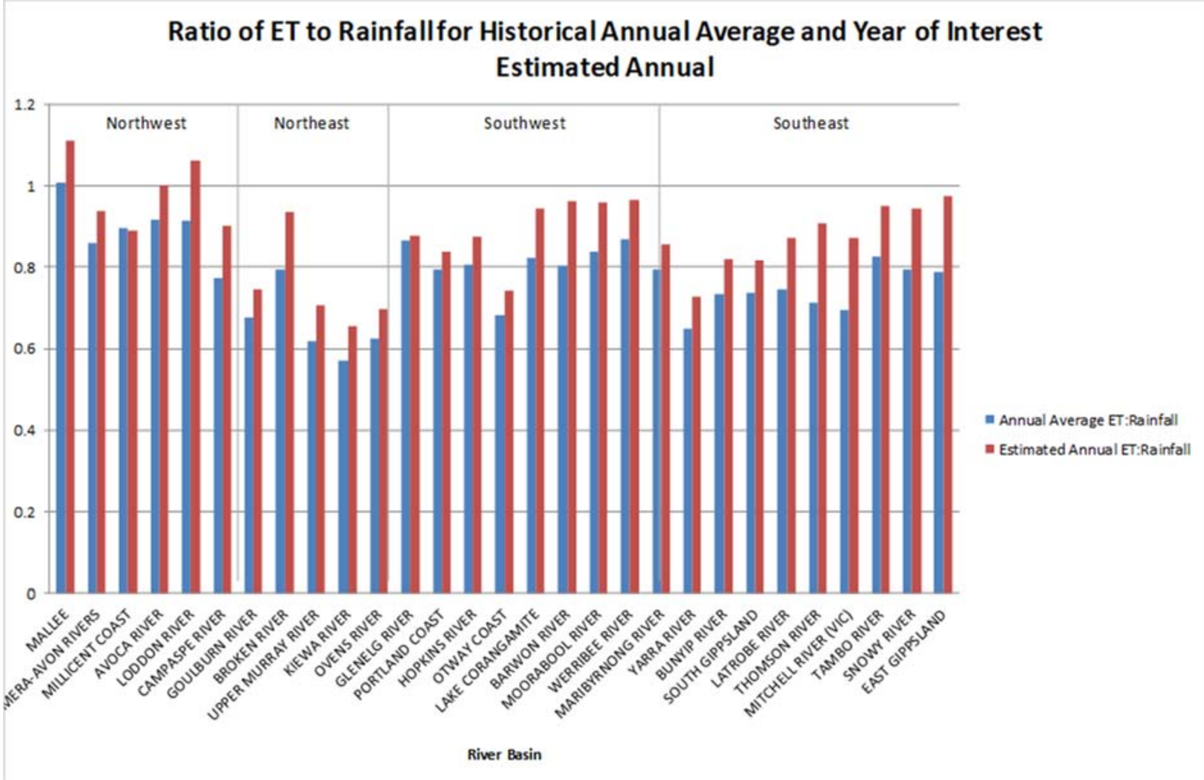


Figure A-2 illustrates evapotranspiration as a proportion of rainfall in Victoria's basins. In 2017–18, the proportion of evapotranspiration to rainfall was generally higher than the long-term average in most basins, except for areas in the south-west and north-east. This is consistent with below-average rainfall generally being observed, because the proportion of evapotranspiration to rainfall generally decreases as rainfall increases. Resultantly, less rainfall remained for streamflow and groundwater recharge in 2017–18 than would be the case in an average year.

Figure A-2 Modelled evapotranspiration as a percentage of rainfall, 2017–18



North-east Victoria (Goulburn to Upper Murray basins)

Below-average rainfall over north-east Victoria in 2017–18 resulted in estimates of evapotranspiration that were generally below average for the north-eastern basins. The estimated evapotranspiration ranged from 464 mm in the Broken basin to 766 mm in the Kiewa basin, and comparisons with the long-term average ranged from 7% below average in the Broken basin to 9% above average in the Kiewa basin (Figure A-1).

In 2017–18, evapotranspiration as a proportion of rainfall in the north-eastern basins was higher than the long-term average. The Broken basin was estimated to have the north-east's highest evapotranspiration as a proportion of rainfall (93%, compared to the long term average of 79%), and the lowest was in the Kiewa basin (65%, compared to the long term average of 57%) (Figure A-2).

South-east Victoria (East Gippsland to Yarra basins)

Notably below-average rainfall over south-eastern Victoria in 2017–18 resulted in estimates of evapotranspiration that were below average for the south-eastern basins. The estimated evapotranspiration ranged from 621 mm in the Tambo basin to 716 mm in the East Gippsland basin, and comparisons with the long-term average ranged from 17% below average in the Snowy and East Gippsland basins to 2% below average in the Yarra basin (Figure A-1).

In 2017–18, evapotranspiration as a proportion of rainfall in the south-eastern basins was higher than the long-term average. The East Gippsland basin was estimated to have the south-east's highest evapotranspiration as a proportion of rainfall (97%, compared to the long term average of 79%), and the lowest was in the Yarra basin (72%, compared to the long term average of 65%) (Figure A-2).

South-west Victoria (Maribyrnong to Glenelg basins)

Rainfall over south-western Victoria was above average in spring in 2017–18; in other months, it was average to below average. This resulted in estimates of evapotranspiration that were generally below average for the south-western basins, except for the Portland Coast and Otway Coast basins. The estimated evapotranspiration ranged from 487 mm in the Moorabool basin to 725 mm in the Otway Coast basin, and comparisons with the long-term average ranged from 12% below average in the Werribee basin to 4% above average in the Portland Coast basin (Figure A-1).

In 2017–18, evapotranspiration as a proportion of rainfall in the south-western basins was higher than the long-term average. The Werribee basin was estimated to have the south-west's highest evapotranspiration as a proportion of rainfall (97%, compared to the long term average of 87%) and the lowest was in the Otway Coast basin (74%, compared to the long term average of 68%) (Figure A-2).

North-west Victoria (Mallee to Campaspe basins)

Below-average rainfall over north-western Victoria in 2017–18 resulted in estimates of evapotranspiration that were below average for the north-western basins. The estimated evapotranspiration ranged from 273 mm in the Mallee basin to 468 mm in the Campaspe basin, and comparisons with the long-term average ranged from 21% below average in the Avoca basin to 3% below average in the Millicent Coast basin (Figure A-1).

In 2017–18, evapotranspiration as a proportion of rainfall in the north-western basins was generally higher than the long term average. The Mallee basin was estimated to have the north-west's highest evapotranspiration as a proportion of rainfall (111%, compared to the long term average of 101%), and the lowest was in the Millicent Coast basin (89%, compared to the long term average of 90%) (Figure A-2).

Key assumptions and data limitations

The estimates of evapotranspiration presented in this appendix are based on results from the SoilFlux model, which is a one-dimensional water balance model. Modelling evapotranspiration requires many approximations and assumptions, which limit the accuracy of the estimates. Major assumptions and limitations of the method used to derive the estimates of evapotranspiration include:

- not accounting for water applied by irrigation
- not allowing for changes in water storage (i.e. rises and falls in the water table and soil moisture) or lateral flow
- aggregating 2016 land use information into a series of ten representative land use classes to facilitate water balance modelling; the 2017 land use data was not available in a suitable format in time for this analysis and the 2016 data has been applied, consistent with the *Victorian Water Accounts 2016–17*
- performing this analysis at a one-kilometre gridded resolution.

The basin areas used to report evapotranspiration estimates are slightly different from those used for reporting in the basin water accounts in Chapter 6. In the basin water accounts, the Murray basin captures information about Murray River irrigation districts in the Mallee, Avoca, Loddon, Campaspe, Goulburn and Broken basins. For evapotranspiration reporting, these irrigation districts are included within their host river basin: for example, the Mildura Irrigation District is in the Mallee basin. However, as noted above, the evapotranspiration estimates do not account for water applied by irrigation.

Appendix B: Storage levels

Basin	Reservoir	On-stream / off-stream	Storage capacity (ML)	% full at 1 July 2017	% full at 30 June 2018
Murray	Kangaroo Lake	Off-stream	39,200	80%	80%
	Kow Swamp	Off-stream	51,710	69%	71%
	Lake Boga	Off-stream	37,000	55%	76%
	Lake Charm	Off-stream	22,000	138%	92%
	Lake Cullulleraine	Off-stream	0	0%	0%
	Lake Dartmouth (Victoria's share)	On-stream	1,928,116	87%	100%
	Lake Hume (Victoria's share)	On-stream	1,502,579	83%	54%
	Lake Victoria (Victoria's share)	On-stream	338,500	67%	54%
	Menindee Lakes (Victoria's accessible share)	On-stream	865,500	31%	0%
Kiewa	Clover Pondage	Off-stream	255	46%	53%
	Lake Guy	On-stream	1,416	40%	32%
	Pretty Valley Basin	Off-stream	355	100%	100%
	Rocky Valley	On-stream	28,294	46%	51%
Ovens	Lake Buffalo	On-stream	23,340	56%	59%
	Lake William Hovell	On-stream	13,690	91%	98%
Broken	Lake Nillahcootie	On-stream	40,400	77%	55%
	Loombah-McCall Say	On-stream	1,747	100%	55%
Goulburn	Goulburn Weir	On-stream	25,500	95%	93%
	Greens Lake	Off-stream	32,500	70%	64%
	Lake Eildon	On-stream	3,334,158	63%	55%
	Sunday Creek Reservoir	On-stream	1,650	59%	59%
	Waranga Basin	Off-stream	432,360	53%	46%
Campaspe	Campaspe Weir	On-stream	2,624	103%	93%
	Lake Eppalock	On-stream	304,651	89%	61%
	Lauriston Reservoir	On-stream	19,790	87%	79%
	Malmsbury Reservoir	On-stream	12,034	16%	23%
	Upper Coliban Reservoir	On-stream	37,770	93%	155%
Loddon	Cairn Curran Reservoir	On-stream	147,130	75%	53%
	Evansford Reservoir	Off-stream	1,346	74%	75%
	Hepburn Lagoon	On-stream	2,457	65%	48%
	Laanecoorie Reservoir	On-stream	8,000	40%	38%
	Newlyn Reservoir	On-stream	3,012	68%	52%
	Sandhurst Reservoir	Off-stream	2,595	53%	84%
	Spring Gully Reservoir	Off-stream	1,680	62%	55%
	Tullaroop Reservoir	On-stream	72,950	73%	56%
East Gippsland	None	-	-	-	-
Snowy	None	-	-	-	-
Tambo	None	-	-	-	-
Mitchell	None	-	-	-	-
Thomson	Lake Glenmaggie	On-stream	177,628	26%	24%
	Thomson Reservoir	On-stream	1,068,000	60%	57%
Latrobe	Blue Rock Lake	On-stream	198,280	90%	85%
	Lake Narracan	On-stream	6,257	19%	98%
	Moondarra Reservoir	On-stream	30,458	64%	78%
South Gippsland	Candowie Reservoir	On-stream	4,463	54%	56%
	Hyland Reservoir	On-stream	671	49%	29%
	Lance Creek Reservoir	On-stream	4,200	74%	73%
	Western Reservoir	On-stream	1,137	38%	69%
Bunyip	Tarago Reservoir	On-stream	37,580	88%	79%
Yarra	Cardinia Reservoir	Off-stream	286,911	66%	59%
	Greenvale Reservoir	Off-stream	26,839	84%	85%
	Maroondah Reservoir	On-stream	22,179	39%	54%
	O'Shannassy Reservoir	On-stream	3,123	81%	85%
	Silvan Reservoir	Off-stream	40,445	87%	88%

Basin	Reservoir	On-stream / off-stream	Storage capacity (ML)	% full at 1 July 2017	% full at 30 June 2018
	Sugarloaf Reservoir	Off-stream	96,253	70%	58%
	Upper Yarra Reservoir	On-stream	200,579	48%	48%
	Yan Yean Reservoir	On-stream	30,266	87%	82%
Maribyrnong	Rosslynne Reservoir	On-stream	25,368	38%	24%
Werribee	Djerriwarrh Reservoir	On-stream	1,014	95%	75%
	Melton Reservoir	On-stream	14,364	51%	23%
	Merrimu Reservoir (total)	On-stream	32,516	50%	37%
	Pykes Creek Reservoir	On-stream	22,119	81%	75%
Moorabool	Bostock Reservoir	On-stream	7,455	58%	40%
	Korweinguboora Reservoir	On-stream	2,327	44%	1%
	Lal Lal Reservoir	On-stream	59,549	53%	77%
	Moorabool Reservoir	On-stream	6,192	70%	44%
	Upper Stony Creek Reservoir	Off-stream	9,494	57%	52%
	Wilsons Reservoir	On-stream	1,010	9%	3%
Barwon	Gong Gong Reservoir	On-stream	1,902	80%	71%
	West Barwon Reservoir	On-stream	22,064	40%	31%
	White Swan Reservoir	On-stream	14,107	87%	73%
	Wurdee Boluc Reservoir	Off-stream	40,431	57%	48%
Corangamite	None	-	-	-	-
Otway Coast	West Gellibrand Reservoir	On-stream	1,856	71%	100%
Hopkins	None	-	-	-	-
Portland Coast	None	-	-	-	-
Glenelg	Konongwootong Reservoir	On-stream	1,920	95%	95%
	Moora Moora Reservoir	On-stream	6,300	60%	57%
	Rocklands Reservoir	On-stream	296,000	43%	38%
Millicent Coast	None	-	-	-	-
Wimmera	Dock Lake [(1)]	On-stream	4,420	0%	0%
	Fyans Lake	On-stream	18,460	75%	69%
	Green Lake	On-stream	5,350	64%	53%
	Lake Bellfield	On-stream	78,560	81%	79%
	Lake Lonsdale	On-stream	65,480	50%	27%
	Pine Lake [(1)]	On-stream	6,200	0%	0%
	Taylors Lake	On-stream	27,060	76%	65%
	Toolondo Reservoir	On-stream	50,533	27%	32%
	Wartook Reservoir	On-stream	29,300	73%	50%
Mallee	None	-	-	-	-
Avoca	None	-	-	-	-
Total			**12,422,929**		

Notes

(1) Dock Lake and Pine Lake are no longer operational storages and are only used in accordance with the storage management rules for flood mitigation purposes

Appendix C: Groundwater entitlement and use

GMU	PCV	Licenses				Domestic and stock		Total use (licensed + domestic and stock)
		Licensed entitlement (ML)	No. of licences	No. of metered bores	Usage (ML)	No. of domestic and stock bores (1)	Estimated use (ML) (2)	
Goulburn–Murray Water								
Water supply protection areas								
Katunga (3)	60,577	60,219	249	179	31,973	736	1,472	33,445
Loddon Highlands (4)	20,697	20,502	179	238	7,215	487	974	8,189
Lower Campaspe Valley	55,875	55,860	133	152	37,432	520	1,040	38,472
Upper Ovens (5)	n/a	3,650	101	87	977	248	496	1,473
Groundwater management areas								
Barnawartha	2,100	375	4	6	9	24	48	57
Broken	3,732	2,801	65	72	478	400	800	1,278
Central Victorian Mineral Springs	6,024	5,014	144	112	1,209	1,265	2,530	3,739
Eildon	1,496	598	26	14	189	274	548	737
Kiewa	3,852	3,114	103	69	422	266	532	954
Lower Ovens	25,200	19,905	263	196	5,758	1,452	2,904	8,662
Mid-Goulburn	12,470	12,470	64	58	3,336	121	242	3,578
Mid-Loddon	34,037	33,877	100	128	24,721	328	656	25,377
Shepparton Irrigation Region (6) (7)	n/a	188,447	1,061	0	76,610	1,252	2,504	79,114
Strathbogie	1,660	1,417	56	29	457	268	536	993
Upper Goulburn	8,568	6,064	113	72	993	524	1,048	2,041
Upper Murray	7,674	3,483	73	55	450	192	384	834
West Goulburn	n/a	2,814	42	0	1,205	1	2	1,207
Outside management units								
Goulburn–Murray Water	n/a	12,895	91	0	2,756	723	1,446	4,202
GWMWater								
Groundwater management areas								
Murrayville (8)	11,005	9,755	39	31	8,331	183	366	8,697
West Wimmera (9) (10)	57,409	53,603	171	200	27,310	623	1,246	28,556
Outside management units								
Grampians Wimmera Mallee Water	n/a	9,059	47	19	1,630	311	622	2,252
Southern Rural Water								
Water supply protection areas								
Condah	7,475	7,470	33	41	3,073	318	477	3,550
Deutgam (11)	5,100	5,082	148	148	912	37	56	968
Glenelg	33,262	16,092	37	52	4,632	1,041	1,562	6,194
Koo-Wee-Rup	12,915	12,655	349	195	3,458	911	1,367	4,825
Sale	21,238	21,203	113	118	14,447	405	608	15,055
Warrion	14,086	14,079	132	128	3,466	237	356	3,822
Yarram	25,690	25,574	88	88	14,074	258	387	14,461
Groundwater management areas								
Bungaree	5,334	5,293	97	154	2,967	159	239	3,206
Cardigan	3,967	3,899	23	22	742	79	119	861
Colongulac	4,695	4,406	67	38	1,287	95	143	1,430
Corinella	2,550	662	13	9	56	57	86	142
Cut Paw Paw	3,650	514	4	3	18	4	6	24
Denison (12)	18,502	18,499	119	112	8,148	200	300	8,448
Frankston	3,200	2,195	26	23	119	81	122	241
Gellibrand)	n/a	0	0	0	0	0	0	0

GMU	PCV	Licenses				Domestic and stock		Total use (licensed + domestic and stock)
		Licensed entitlement (ML)	No. of licences	No. of metered bores	Usage (ML)	No. of domestic and stock bores (1)	Estimated use (ML) (2)	
Gerangamete (13)	20,000	20,000	1	6	3	5	8	11
Giffard	5,689	5,689	18	18	3,784	89	134	3,918
Glenormiston	2,698	2,636	45	27	1,382	65	98	1,480
Jan Juc (14)	14,250	14,250	3	8	7	3	5	12
Lancefield	1,485	1,378	15	18	339	48	72	411
Leongatha	6,500	1,803	33	12	170	71	107	277
Merrimu	451	0	0	0	0	11	17	17
Moe	8,200	3,888	96	34	904	109	164	1,068
Moorabbin	2,700	2,581	54	81	1,212	188	282	1,494
Nepean (9)	6,110	6,110	74	80	3,024	1,734	1,734	4,758
Newlingrook	1,977	1,958	6	6	47	2	3	50
Orbost	1,217	1,217	4	5	537	3	5	542
Paaratte (15)	4,606	3,212	6	1	334	2	3	337
Portland	7,795	7,794	8	7	2,501	1	2	2,503
Rosedale (9) (16)	22,372	22,322	72	53	8,844	85	128	8,972
South West Limestone (17)	n/a	81,577	831	647	34,128	5,206	7,810	41,938
Stratford (9) (16) (18)	27,686	37,043	10	5	22,076	4	8	22,084
Tarwin	1,300	58	4	2	15	432	648	663
Wa De Lock (9) (12)	30,795	29,140	251	175	8,708	395	593	9,301
Wandin Yallock (18)	3,027	3,006	194	195	664	48	72	736
Wy Yung (9)	7,463	7,462	60	70	1,326	33	50	1,376
Outside management units								
Southern Rural Water	n/a	70,431	1,332	783	13,536	4,851	7,277	20,813
Total 2017–18	**650,361**	**967,100**	**7,490**	**5,081**	**394,401**	**27,465**	**45,444**	**439,845**
Total 2016–17	673,429	971,575	7,085	5,276	304,212	28,674	47,460	351,672

Notes

(1) The number of unlicensed domestic and stock bores includes all bores from the groundwater management system that are less than 30 years old. Bore depths (where recorded) have been taken into account to ensure that domestic and stock bores are assigned to the appropriate GMU where management units overlap.

(2) Domestic and stock use is estimated as 2 ML per bore except for the Southern Rural Water GMUs, where 1.5 ML per bore has been used (unless otherwise noted) and the Nepean GMA, where 1 ML per bore is used as a more-accurate estimate.

(3) Extractions from Katunga WSPA were restricted to 70% allocation at the start of 2017–18 and were then lifted and able to access 100% by September 2017.

(4) Extractions from Newlyn trading zone in the Loddon Highlands WSPA were restricted to 75% allocation.

(5) The Minister approved the revocation of the PCV on 3 March 2013.

(6) There is no PCV for the Shepparton Irrigation GMA as there is no limit on the total volume of shallow groundwater entitlement available.

(7) Groundwater use in the Shepparton Irrigation Region GMA is estimated at the end of each season using a method which considers annual use by a subset of Shepparton Irrigation Region GMA licensed groundwater users that are metered; the volume of metered groundwater use in the Katunga Water Supply Protection Area, and spring rainfall.

(8) In July 2017, the WSPA status for Murrayville was abolished and a new PCV was established.

(9) The PCV that applies to West Wimmera GMA, Wy Yung GMA, Nepean GMA, Rosedale GMA, Stratford GMA and Wa De Lock GMA total the sum of the PCVs for all zones within each GMU.

(10) Extractions from Neuarpur subzone 1 (a trading zone in the West Wimmera GMA) were restricted to 80% allocation.

(11) Extractions from Deutgam WSPA were restricted to 50% allocation at the beginning of 2017–18 and were then lifted to 100% by December 2017.

(12) The volume of use in Denison and Wa De Lock GMA includes metered extractions for salinity control (Denison WSPA 1,003 ML and Wa De Lock GMA 1,130 ML).

(13) The PCV for the Gerangamete GMA is aligned with Barwon Water's groundwater licence, which allows extraction from the Gerangamete GMA of a maximum of 20,000 ML in any one year, 80,000 ML over a consecutive 10-year period and 400,000 ML over a 100-year period.

(14) The PCV for Jan Juc GMA is Zone 1 all formations 250 ML, Zone 2 Upper Eastern View formation 4,000 ML and Zone 2 Lower Eastern View formation 35,000 ML in any five-year period. The Jan Juc bulk entitlement, which applies to Zone 2 Lower Eastern View formation, is based on a five-year total of 35,000 ML with a maximum annual extraction of 10,000 ML. The total of 14,250 ML includes 4,250 ML and the maximum annual bulk entitlement extraction volume of 10,000 ML.

(15) The Paaratte GMA PCV was amended on 23rd April 2018. 4,606 ML or 4,606 plus additional volume that may be taken under a section 51 licence for take and use of groundwater for a single pumping test or managed aquifer recharge scheme. Licensed entitlements must not exceed 4,692 ML.

(16) The use volumes reported in Rosedale and Stratford GMAs includes metered extractions from Latrobe Valley coal mines (Rosedale GMA 900 ML and Stratford GMA 22,058 ML).

(17) The PCV for the South West Limestone GMA has not been gazetted. The entitlements and use relate to the area defined in the *South West Limestone Groundwater Management Area Plan* No. LEGL./15-199. The South West Limestone GMA includes the area of the former Nullawarre WSPA, Yangery WSPA, Hawkesdale GMA and Heywood GMA, and the areas outside the former GMUs but included within the South West Limestone GMA area. Abolition of the Nullawarre and Yangery WSPAs was approved on 24 October 2014 and published in the Victorian Government Gazette on 30 October 2014. The PCVs for the four GMUs have not been revoked and still apply. PCV volumes are Nullawarre 22,741 ML, Yangery 14,352 ML, Hawkesdale 16,161 ML and Heywood 8,500 ML.

(18) The PCV for the Stratford GMA and the Wandin Yallock GMA was amended on 1 May 2018.

n/a Not applicable.

Appendix D: Bulk entitlement holders

River basin	Entitlements	Holder
Murray	*Bulk Entitlement (Corryong) Conversion Order 2000*	North East Water
	Bulk Entitlement (Cudgewa) Conversion Order 2000	North East Water
	Bulk Entitlement (Dartmouth) Conversion Order 2000	North East Water
	Bulk Entitlement (Omeo) Conversion Order 2008	East Gippsland Water
	Bulk Entitlement (River Murray – City West Water) Order 2012	City West Water
	Bulk Entitlement (River Murray – Coliban Water) Conversion Order 1999	Coliban Water
	Bulk Entitlement (River Murray – Flora and Fauna) Conversion Order 1999	Victorian Environmental Water Holder
	Bulk Entitlement (River Murray – Goulburn Valley Water) Conversion Order 1999	Goulburn Valley Water
	Bulk Entitlement (River Murray - Goulburn-Murray Water) Conversion Order 1999	Goulburn-Murray Water
	Bulk Entitlement (River Murray – Grampians Wimmera Mallee Water) Conversion Order 1999	Grampians Wimmera Mallee Water
	Bulk Entitlement (River Murray – Lower Murray Urban and Rural Water – Irrigation) Conversion Order 1999	Lower Murray Water
	Bulk Entitlement (River Murray – Lower Murray Urban and Rural Water – Urban) Conversion Order 1999	Lower Murray Water
	Bulk Entitlement (River Murray – North East Water) Conversion Order 1999	North East Water
	Environmental Entitlement (River Murray – NVIRP Stage 1) 2012	Victorian Environmental Water Holder
	Bulk Entitlement (River Murray – Snowy Environmental Reserve) Conversion Order 2004	Victorian Environmental Water Holder
	Bulk Entitlement (River Murray – South East Water) Order 2012	South East Water
	Bulk Entitlement (River Murray – Yarra Valley Water) Order 2012	Yarra Valley Water
	Bulk Entitlement (Walwa) Conversion Order 2000	North East Water
Kiewa	*Bulk Entitlement (Kiewa – Hydro) Conversion Order 1997*	AGL Hydro Partnership
	Bulk Entitlement (Kiewa – Tangambalanga) Conversion Order 2000	North East Water
	Bulk Entitlement (Mount Beauty – Tawonga) Conversion Order 1997	North East Water
	Bulk Entitlement (Yackandandah) Conversion Order 2001	North East Water
Ovens	*Bulk Entitlement (Beechworth) Conversion Order 2001*	North East Water
	Bulk Entitlement (Bright) Conversion Order 2000	North East Water
	Bulk Entitlement (Chiltern) Conversion Order 2000	North East Water
	Bulk Entitlement (Glenrowan) Conversion Order 1999	North East Water
	Bulk Entitlement (Harrietville) Conversion Order 1999	North East Water
	Bulk Entitlement (Myrtleford) Conversion Order 2001	North East Water
	Bulk Entitlement (Ovens System - Goulburn-Murray Water) Conversion Order 2004	Goulburn-Murray Water
	Bulk Entitlement (Ovens System – Moyhu, Oxley and Wangaratta – North East Water) Conversion Order 2004	North East Water
	Bulk Entitlement (Springhurst) Conversion Order 1999	North East Water
	Bulk Entitlement (Whitfield) Conversion Order 1999	North East Water
Broken	*Bulk Entitlement (Broken System - Goulburn-Murray Water) Conversion Order 2004*	Goulburn-Murray Water
	Bulk Entitlement (Broken System - Tungamah, Devenish & St James - North East Water) Conversion Order 2004	North East Water
	Bulk Entitlement (Loombah McCall-Say) Conversion Order 2001	North East Water
Goulburn	*Bulk Entitlement (Broadford, Kilmore & Wallan) Conversion and Augmentation Order 2003*	Goulburn Valley Water
	Bulk Entitlement (Buxton) Conversion Order 1995	Goulburn Valley Water
	Bulk Entitlement (Eildon – Goulburn Weir) Conversion Order 1995	Goulburn-Murray Water
	Environmental Entitlement (Goulburn System – Living Murray) 2007	Victorian Environmental Water Holder
	Bulk Entitlement (Euroa System) Conversion Order 2001	Goulburn Valley Water
	Bulk Entitlement (Goulburn Channel System - Coliban Water) Order 2012	Coliban Water
	Bulk Entitlement (Goulburn Channel System - Goulburn Valley Water) Order 2012	Goulburn Valley Water
	Bulk Entitlement (Goulburn River & Eildon - Goulburn Valley Water) Order 2012	Goulburn Valley Water
	Goulburn River Environmental Entitlement 2010	Victorian Environmental Water Holder

River basin	Entitlements	Holder
	Bulk Entitlement (Goulburn System – City West Water) Order 2012	City West Water
	Environmental Entitlement (Goulburn System – NVIRP Stage 1) 2012	Victorian Environmental Water Holder
	Bulk Entitlement (Goulburn System – Snowy Environmental Reserve) Order 2004	Victorian Environmental Water Holder
	Bulk Entitlement (Goulburn System – South East Water) Order 2012	South East Water
	Bulk Entitlement (Goulburn System – Yarra Valley Water) Order 2012	Yarra Valley Water
	Bulk Entitlement (Longwood) Conversion Order 1995	Goulburn Valley Water
	Bulk Entitlement (Mansfield) Conversion Order 1995	Goulburn Valley Water
	Bulk Entitlement (Marysville) Conversion Order 1995	Goulburn Valley Water
	Bulk Entitlement (Pyalong) Conversion Order 1997	Goulburn Valley Water
	Bulk Entitlement (Quambatook - Grampians Wimmera-Mallee Water) Order 2006	Grampians Wimmera Mallee Water
	Bulk Entitlement (Rubicon - Hydro) Conversion Order 1997	AGL Hydro Partnership
	Silver & Wallaby Creeks Environmental Entitlement 2006	Victorian Environmental Water Holder
	Bulk Entitlement (Silver & Wallaby Creeks - Melbourne Water) Order 2014	Melbourne Water
	Bulk Entitlement (Strathbogie) Conversion Order 2012	Goulburn Valley Water
	Bulk Entitlement (Thornton) Conversion Order 1995	Goulburn Valley Water
	Bulk Entitlement (Upper Delatite) Conversion Order 1995	Goulburn Valley Water
	Bulk Entitlement (Violet Town) Conversion Order 1997	Goulburn Valley Water
	Bulk Entitlement (Woods Point) Conversion Order 1995	Goulburn Valley Water
	Bulk Entitlement (Yea) Conversion Order 1997	Goulburn Valley Water
Campaspe	*Bulk Entitlement (Axedale, Goornong and Part Rochester) Conversion Order 1999*	Coliban Water
	Campaspe River Environmental Entitlement 2013	Victorian Environmental Water Holder
	Bulk Entitlement (Campaspe System – Coliban Water) Conversion Order 1999	Coliban Water
	Bulk Entitlement (Campaspe System - Goulburn-Murray Water) Conversion Order 2000	Goulburn-Murray Water
	Environmental Entitlement (Campaspe River – Living Murray Initiative) 2007	Victorian Environmental Water Holder
	Bulk Entitlement (Trentham) Conversion Order 2012	Coliban Water
	Bulk Entitlement (Woodend) Conversion Order 2004	Western Water
Loddon	*Environmental Entitlement (Birch Creek – Bullarook System) 2009*	Victorian Environmental Water Holder
	Bulk Entitlement (Bullarook System - Central Highlands Water) Conversion Order 2009	Central Highlands Water
	Bulk Entitlement (Bullarook System - Goulburn-Murray Water) Conversion Order 2009	Goulburn-Murray Water
	Bulk Entitlement (Creswick) Conversion Order 2004	Central Highlands Water
	Bulk Entitlement (Daylesford-Hepburn Springs) Conversion Order 2004	Central Highlands Water
	Bulk Entitlement (Evansford-Talbot System – Part Maryborough – Central Highlands Water) Conversion Order 2006	Central Highlands Water
	Bulk Entitlement (Lexton) Conversion Order 2004	Central Highlands Water
	Bulk Entitlement (Loddon River – Environmental Reserve) Order 2005	Victorian Environmental Water Holder
	Bulk Entitlement (Loddon System – Coliban Water) Conversion Order 2005	Coliban Water
	Bulk Entitlement (Loddon System - Goulburn-Murray Water) Conversion Order 2005	Goulburn-Murray Water
	Bulk Entitlement (Loddon System – Part Maryborough – Central Highlands Water) Conversion Order 2005	Central Highlands Water
East Gippsland	*Bulk Entitlement (Bemm River) Conversion Order 1997*	East Gippsland Water
	Bulk Entitlement (Cann River) Conversion Order 1997	East Gippsland Water
	Bulk Entitlement (Mallacoota) Conversion Order 1997	East Gippsland Water
Snowy	*Bulk Entitlement (Buchan) Conversion Order 1997*	East Gippsland Water
	Bulk Entitlement (Orbost System) Conversion Order 1997	East Gippsland Water
Tambo	*Bulk Entitlement (Nowa Nowa) Conversion Order 1997*	East Gippsland Water
	Bulk Entitlement (Swifts Creek) Conversion Order 1997	East Gippsland Water
Mitchell	*Bulk Entitlement (Bairnsdale) Conversion Order 2000*	East Gippsland Water
Thomson	*Macalister River Environmental Entitlement 2010*	Victorian Environmental Water Holder
	Bulk Entitlement (Thomson Macalister – Southern Rural Water) Conversion Order 2001	Southern Rural Water
	Bulk Entitlement (Thomson Macalister Towns – Gippsland Water) Conversion Order 2005	Gippsland Water
	Bulk Entitlement (Thomson River – Melbourne Water) Order 2014	Melbourne Water
	Bulk Entitlement (Thomson River – Environment) Order 2005	Victorian Environmental Water Holder
Latrobe	*Blue Rock Environmental Entitlement 2013*	Victorian Environmental Water Holder
	Bulk Entitlement (Boolarra) Conversion Order 1997	Gippsland Water
	Bulk Entitlement (Gippsland Water – Blue Rock) Conversion Order 1997	Gippsland Water

River basin	Entitlements	Holder
	Bulk Entitlement (Erica) Conversion Order 1997	Gippsland Water
	Bulk Entitlement (Latrobe – Southern Rural) Conversion Order 1996	Southern Rural Water
	Lower Latrobe Wetlands Environmental Entitlement 2010	Victorian Environmental Water Holder
	Bulk Entitlement (Mirboo North) Conversion Order 1997	Gippsland Water
	Bulk Entitlement (Moe – Narracan Creek) Conversion Order 1998	Gippsland Water
	Bulk Entitlement (Moondarra Reservoir) Conversion Order 1997	Gippsland Water
	Bulk Entitlement (Noojee) Conversion Order 1997	Gippsland Water
	Bulk Entitlement (Thorpdale) Conversion Order 1997	Gippsland Water
	Bulk Entitlement (Latrobe - Loy Yang B) Conversion Order 1996	Southern Rural Water
	Bulk Entitlement (Latrobe - Loy Yang A) Conversion Order 1996	AGL Loy Yang Partnership
	Bulk Entitlement (Latrobe - Loy Yang 3/4 Bench) Conversion Order 1996	Minister for Energy, Environment and Climate Change (on behalf of the Victorian Government)
	Bulk Entitlement (Latrobe - Yallourn) Conversion Order 1996	Energy Australia
	Bulk Entitlement (Latrobe Reserve) Order 2013	Southern Rural Water
South Gippsland	*Bulk Entitlement (Devon North, Alberton, Yarram & Port Albert) Conversion Order 1997*	South Gippsland Water
	Bulk Entitlement (Dumbalk) Conversion Order 1997	South Gippsland Water
	Bulk Entitlement (Fish Creek) Conversion Order 1997	South Gippsland Water
	Bulk Entitlement (Foster) Conversion Order 1997	South Gippsland Water
	Bulk Entitlement (Korumburra) Conversion Order 1997	South Gippsland Water
	Bulk Entitlement (Leongatha) Conversion Order 1997	South Gippsland Water
	Bulk Entitlement (Loch, Poowong & Nyora) Conversion Order 1997	South Gippsland Water
	Bulk Entitlement (Meeniyan) Conversion Order 1997	South Gippsland Water
	Bulk Entitlement (Desalinated Water - City West Water) Order 2014	City West Water
	Bulk Entitlement (Desalinated Water - South East Water) Order 2014	South East Water
	Bulk Entitlement (Desalinated Water - Yarra Valley Water) Order 2014	Yarra Valley Water
	Bulk Entitlement (Seaspray) Conversion Order 1997	Gippsland Water
	Bulk Entitlement (Toora, Port Franklin, Welshpool & Port Welshpool) Conversion Order 1997	South Gippsland Water
	Bulk Entitlement (Westernport) Conversion Order 1997	Westernport Water
	Bulk Entitlement (Westernport – Bass River) Order 2009	Westernport Water
	Bulk Entitlement (Wonthaggi – Inverloch) Conversion Order 1997	South Gippsland Water
Bunyip	*Tarago and Bunyip Rivers Environmental Entitlement 2009*	Victorian Environmental Water Holder
	Bulk Entitlement (Tarago River – Gippsland Water) Conversion Order 2009	Gippsland Water
	Bulk Entitlement (Tarago River – Southern Rural Water) Conversion Order 2009	Southern Rural Water
	Bulk Entitlement (Tarago and Bunyip Rivers - Melbourne Water) Order 2014	Melbourne Water
Yarra	*Bulk Entitlement (Yarra River - Melbourne Water) Order 2014*	Melbourne Water
	Yarra River Environmental Entitlement 2006	Victorian Environmental Water Holder
Maribyrnong	*Bulk Entitlement (Gisborne – Barringo Creek) Conversion Order 2004*	Western Water
	Bulk Entitlement (Lancefield) Conversion Order 2001	Western Water
	Bulk Entitlement (Macedon and Mount Macedon) Conversion Order 2004	Western Water
	Bulk Entitlement (Maribyrnong – Melbourne Water) Conversion Order 2000	Melbourne Water
	Bulk Entitlement (Maribyrnong – Southern Rural Water) Conversion Order 2000	Southern Rural Water
	Bulk Entitlement (Maribyrnong – Western Water) Conversion Order 2000	Western Water
	Bulk Entitlement (Riddells Creek) Conversion Order 2001	Western Water
	Bulk Entitlement (Romsey) Conversion Order 2001	Western Water
Werribee	*Bulk Entitlement (Ballan) Conversion Order 1998*	Central Highlands Water
	Bulk Entitlement (Blackwood & Barry's Reef) Conversion Order 1998	Central Highlands Water
	Bulk Entitlement (Myrniong) Conversion Order 2004	Western Water
	Werribee River Environmental Entitlement 2011	Victorian Environmental Water Holder
	Bulk Entitlement (Werribee System – Irrigation) Conversion Order 1997	Southern Rural Water
	Bulk Entitlement (Werribee System – Western Water) Conversion Order 2004	Western Water
Moorabool	*Bulk Entitlement (Lal Lal – Barwon) Conversion Order 1995*	Barwon Water
	Bulk Entitlement (Lal Lal – Central Highlands) Conversion Order 1995	Central Highlands Water
	Bulk Entitlement (Meredith) Conversion Order 1995	Barwon Water
	Moorabool River Environmental Entitlement 2010	Victorian Environmental Water Holder
	Bulk Entitlement (She Oaks) Conversion Order 1995	Barwon Water
	Bulk Entitlement (Upper East Moorabool System) Conversion Order 1995	Barwon Water
	Bulk Entitlement (Upper West Moorabool System) Conversion Order 1995	Central Highlands Water

River basin	Entitlements	Holder
Barwon	*Barwon River Environmental Entitlement 2011*	Victorian Environmental Water Holder
	Upper Barwon River Environmental Entitlement 2018	Victorian Environmental Water Holder
	Bulk Entitlement (Upper Barwon System) Conversion Order 2002	Barwon Water
	Bulk Entitlement (Yarrowee - White Swan System) Conversion Order 2002	Central Highlands Water
Otway Coast	*Bulk Entitlement (Aireys Inlet) Conversion Order 1997*	Barwon Water
	Bulk Entitlement (Apollo Bay) Order 2010	Barwon Water
	Bulk Entitlement (Colac) Amendment Order 2003	Barwon Water
	Bulk Entitlement (Gellibrand) Conversion Order 1997	Barwon Water
	Bulk Entitlement (Lorne) Conversion Order 1997	Barwon Water
	Bulk Entitlement (Otway System) Conversion Order 1998	Wannon Water
Hopkins	*Bulk Entitlement (Beaufort) Conversion Order 2005*	Central Highlands Water
	Bulk Entitlement (Skipton) Conversion Order 2005	Central Highlands Water
Glenelg	*Bulk Entitlement (Coleraine, Casterton & Sandford) Conversion Order 1997*	Wannon Water
	Bulk Entitlement (Dunkeld System) Conversion Order 1997	Wannon Water
	Bulk Entitlement (Glenthompson) Conversion Order 1997	Wannon Water
	Bulk Entitlement (Hamilton) Conversion Order 1997	Wannon Water
Wimmera	*Bulk Entitlement (Landsborough-Navarre) Conversion Order 2003*	Central Highlands Water
	Bulk Entitlement (Willaura, Elmhurst and Buangor Systems – GWMWater) Conversion Order 2012	Grampians Wimmera Mallee Water
	Bulk Entitlement (Willaura System – Wannon Water) Conversion Order 2012	Wannon Water
	Bulk Entitlement (Wimmera and Glenelg Rivers - Coliban Water) Order 2010	Coliban Water
	Bulk Entitlement (Wimmera and Glenelg Rivers - GWMWater) Order 2010	Grampians Wimmera Mallee Water
	Bulk Entitlement (Wimmera and Glenelg Rivers - Wannon Water) Order 2010	Wannon Water
	Wimmera and Glenelg Rivers Environmental Entitlement 2010	Victorian Environmental Water Holder
Avoca	*Bulk Entitlement (Amphitheatre) Conversion Order 2003*	Central Highlands Water
	Bulk Entitlement (Avoca) Conversion Order 2003	Central Highlands Water
	Bulk Entitlement (Redbank) Conversion Order 2003	Central Highlands Water
Jan Juc GMA	*Bulk Entitlement (Anglesea Groundwater) Order 2009*	Barwon Water

Appendix E: Amendment to the method for estimating small catchment dams

Overview

Small catchment dams are dams that are not located on a defined watercourse but harvest water from their local catchment. Losses occur from small catchment dams when evaporation exceeds the rate of rainfall to the dam surface.

In 2018–19, the method used to estimate harvest and loss from small catchment dams was updated to provide a more-accurate measure. For most basins, this change in method has made a significant difference to all values relating to small catchment dams. These differences are due to improved estimates of the inflows to these dams and also to an improved understanding of how small catchment dams operate from year to year under different climate conditions.

Water harvested for farm dams is considered an inflow to the catchment, so it is included in the calculation of water availability (or catchment inflow) for the basin. Thus, a change to the small catchment dam estimation method will, in turn, affect the catchment inflow value. The significant differences between catchment inflows reported for 2016–17 and 2017–18 for many basins in Victoria should not be interpreted as a loss in available water. Instead, they are a product of the updated calculation method. An explanatory note has been included in the water balance (see Chapter 6) for each basin.

The new method for estimating small catchment dam impacts will be used in future, and further methodology updates will be implemented in future years as modelling techniques and data are improved.

Key improvements

The new method adopted for estimating harvest and loss from small catchment dams in 2017–18 has many advantages over the old approach. Table E-1 outlines the key differences.

Table E-1: Differences between the new and old approaches to estimating small catchment dam figures

	Old approach (up to 2016–17)	New approach (2017–18 onwards)
Annual climate	**Not sensitive to climate** Harvest and loss are typically the same each year. They are based on the long-term average for each basin, except in extreme drought years (such as 1982 and 2007)	**Sensitive to climate** Harvest and loss vary according to the rainfall and streamflow each year. The modelling adopts the latest climate information from the Bureau of Meteorology.
Inflows to each dam	**Assumes all dams have good inflows** Harvest and loss are calculated assuming that each dam has been constructed with an upstream catchment area proportional to the dam capacity.	**Assumes mix of good or bad inflows for each dam** Harvest and loss are calculated based on observed catchment areas for small dams across Victoria. Studies of actual farm dams in Victoria show that some dams fill easily, while others have very small catchments and do not receive much inflow.
Calculation method	**Method was fixed, based on long-term averages calculated in 2004** This approach uses long-term average calculations from 2004. The method was difficult to revise if new data became available.	**Method can easily accommodate new or improved information** This approach uses direct calculation of harvest and loss for each year, based on observed dams and climate. If new information becomes available, this can be immediately incorporated into the calculations the following year.

New method

The new method is based on the approach used in STEDI (Spatial Tool for Estimating Dam Impacts), a software package developed by Victoria between 2000 and 2012[4]. Essentially, the new method uses the following data to estimate the harvest and loss for each small catchment dam, and it then aggregates all dams within each basin:

[4] STEDI is freely available. For more information, refer to https://www.water.vic.gov.au/water-reporting/surface-water-modelling/spatial-tool-for-estimating-dam-impacts-stedi.

- spatial data showing the location and surface area of all small catchment dams [5]
- rainfall, evaporation and streamflow data from the Bureau of Meteorology's AWRA-L model [6]
- demand factors developed by Victoria, which estimate annual on-farm demand as a percentage of dam capacity.

While the calculations are relatively complex, they are based on two practical observations about small catchment dams:

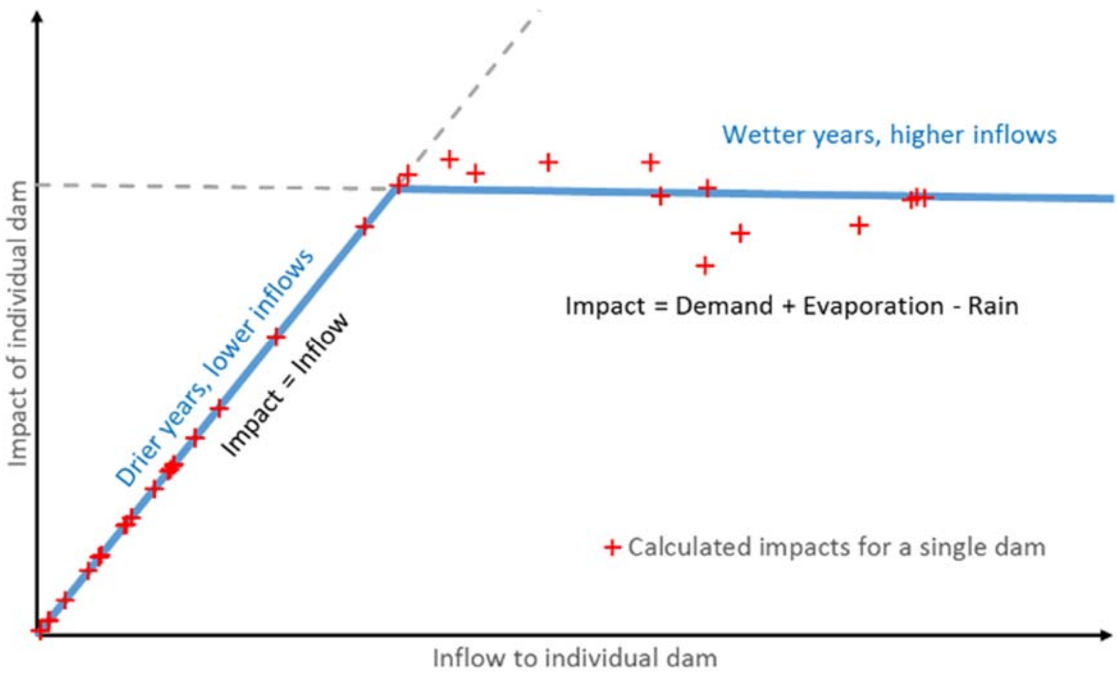
- in wetter years with good inflows, a dam is likely to fill completely with some spills occurring. In this case, the impact of the dam on downstream waterways can be estimated as the sum of on-farm demands plus rainfall and evaporation on the surface of the dam
- in drier years, there may not be enough inflow to fill the dam, and the dam never spills. In such years, the dam harvests all inflows. This means that the impact on downstream waterways is equal to the inflow.

Essentially, this means that the impact on downstream waterways of any dam in any year can be calculated as:

Impact = lesser of (dam inflow) or (demand+climate)

This approach can also be represented graphically, as Figure E-1 shows. Note that the solid line shows the conceptual model, the crosses show calculated impacts for a single dam, using the new method.

Figure E-1 Estimating the annual impact of a small catchment dam



Comparison of old and new values for small catchment dam impacts

Table E-2 shows the long-term average impact of small catchment dams for each basin and the impact of small catchment dams for 2017–18. The table compares the values obtained using the old 2016–17 method with the new 2017–18 method.

[5] Victorian farm dam spatial layer is available at http://data.vic.gov.au.

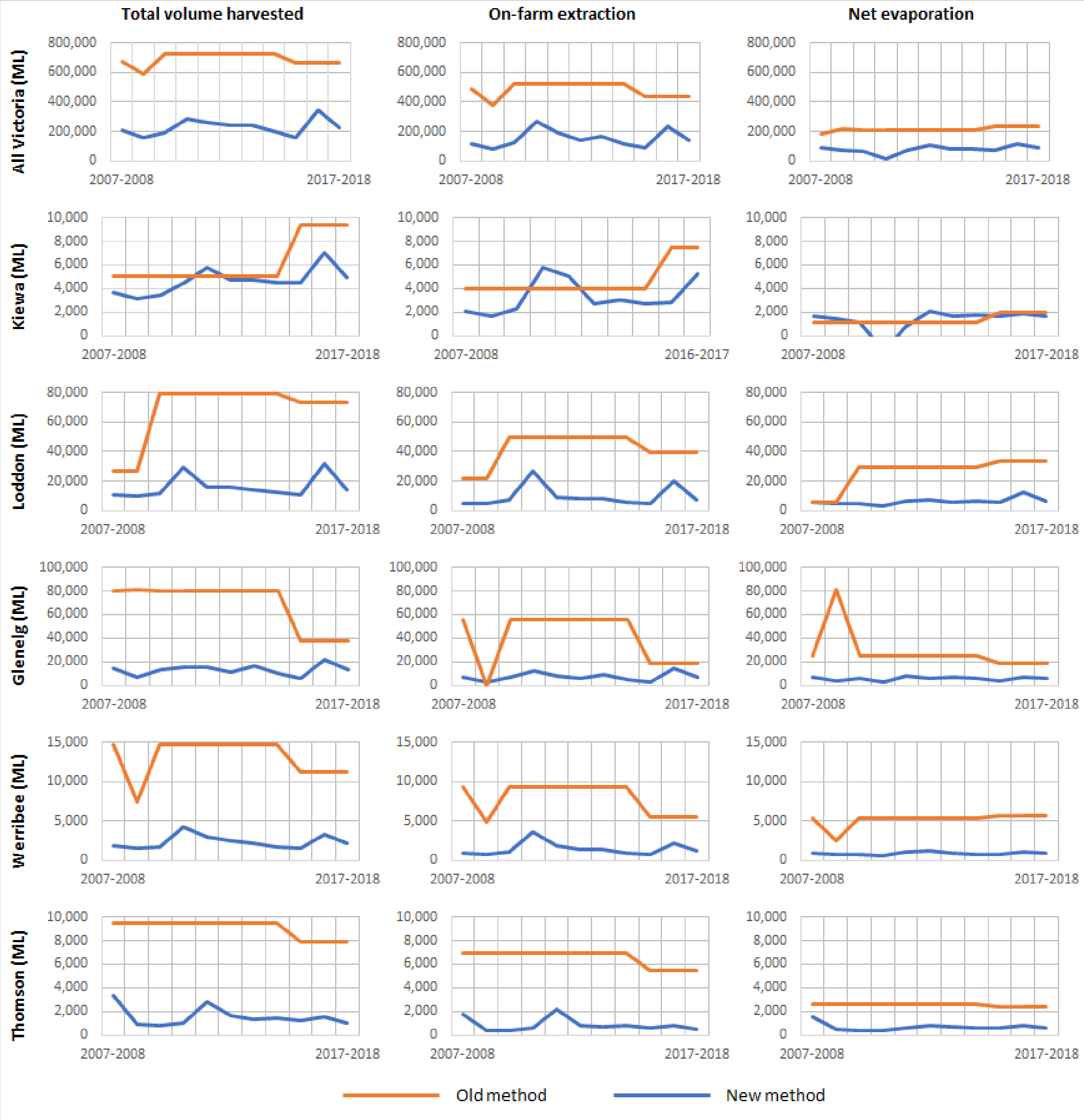
[6] AWRA-L outputs are available at http://www.bom.gov.au/water/landscape.

Table E-2: Comparison of old and new methods for estimating small catchment dam impacts, including long-term average impacts and 2017–18 impacts

Basin	Long term average impact of small catchment dams (ML per year)		Impact of small catchment dams for 2017–18 year (ML per year)	
	Old method	New method (averaged from July 1975 to June 2018)	Old method	New method
Murray	12,000	9,113	12,000	9,938
Kiewa	9,403	5,320	9,403	4,919
Ovens	32,938	14,491	32,938	11,928
Broken	25,391	7,787	25,391	6,179
Goulburn	64,349	30,648	64,349	28,721
Campaspe	42,349	14,955	42,349	13,006
Loddon	73,279	18,420	73,279	14,099
East Gippsland	937	692	937	599
Snowy	3,496	2,207	3,496	2,245
Tambo	5,840	2,460	5,840	2,002
Mitchell	5,467	2,066	5,467	1,291
Thomson	7,872	1892	7,872	1,016
Latrobe	28,412	13,394	28,412	9,958
South Gippsland	36,134	20,595	36,134	20,764
Bunyip	36,076	20,413	36,076	18,583
Yarra	20,784	12,541	20,784	11,414
Maribyrnong	13,554	5,044	13,554	3,796
Werribee	11,212	2,789	11,212	2,084
Moorabool	21,245	5,860	21,245	4,966
Barwon	36,676	9,698	36,676	8,085
Corangamite	14,756	4,204	14,756	3,402
Otway Coast	20,147	11,525	20,147	12,887
Hopkins	39,196	9,060	39,196	6,788
Portland Coast	7,120	2,579	7,120	3,113
Glenelg	37,924	13,067	37,924	12,994
Millicent Coast	8,067	1,645	8,067	1,681
Wimmera	32,409	8,058	32,409	4,893
Avoca	18,314	3,388	18,314	1,927
Total	**163,885**	**51,778**	**163,885**	**48,951**

Figure E-2 shows the total impact on-farm demands and net evaporation due to small catchment dams. The two lines in each graph represent the old method and the new method. Note that for clarity only a small selection of basins has been included.

Figure E-2: Comparison of old and new methods of estimating small catchment dam impacts, on-farm demands and net evaporation, to 2007–08 to 2017–18



These graphs show that:

- the old method used the same long-term average values for every year, except in extreme drought years. In comparison, the new method has different values every year, depending on the annual climate
- the old method shows a change in 2015–16 for all basins, when improved spatial data was introduced to provide a better estimate of the total capacity of dams across Victoria
- the new method more clearly demonstrates the impact of climate variability. For instance, the chart above shows the last few years of the Millennium Drought (1996–2010), followed by a much-wetter year in 2010–11. In absolute terms, a drier year generally results in reduced impact, while a wetter year results in increased impact. The high-rainfall year in 2010–11 had a stronger effect in the north of the state, as demonstrated by results for the Loddon basin, but a lesser effect in the south of the state as demonstrated by results for the Glenelg basin.

Uncertainty and confidence

The method used to calculate the annual impact from small catchment dams involves computing the annual water balance for each of the estimated 383,000 small catchment dams across Victoria. Confidence in estimates of the annual impact is influenced by confidence in several key model inputs, including the:

- storage capacity of each dam
- annual volume of water extracted from each dam for on-farm use

- depth of rain and evaporation on the surface for each dam
- variations in water stored in each dam (and hence surface area) throughout the year
- runoff generated in the catchment upstream of each dam
- area of the catchment upstream of each dam.

A study was commissioned to understand how each of these model inputs influenced the estimated impact of dams. The study revealed that the uncertainty is significant:

- on a statewide basis, the actual annual impact of small catchment dams could be between 50% and 36% lower than the estimate shown in the water accounts
- for most basins, the annual impact shown in the water accounts falls within the 90% confidence limits around the best estimate, after accounting for uncertainties.

This indicates that the estimated annual impacts of small catchment dams, as shown in the water accounts, are reasonably conservative estimates of the actual impacts of these dams on downstream waterways.

The dominant source of uncertainty in estimating the impact of small catchment dams is the volume of runoff generated in the catchment upstream of each dam. This input is obtained from the Bureau of Meteorology model AWRA-L. Upstream runoff directly influences the volume of water captured and stored by each dam and then is available for extraction:

- if it is overestimated, dams appear to have lots of water, which results in high estimates of impact
- if it is underestimated, dams appear to be dry, which results in low estimates of impact.

This model input will be a key focus of future research by DELWP into small catchment dams.