Victorian Water Accounts

2016-2017

A statement of Victorian water resources

VICTORIA State Government | Environment, Land, Water and Planning

Victorian Water Accounts 2016–2017

A statement of Victorian water resources

Foreword

The *2016–17 Victorian Water Accounts* mark 10 years since the lowest annual inflows were recorded, during the Millennium Drought. This anniversary is a timely reminder, as highlighted in *Water for Victoria,* that with accelerated changes in climate, population growth, and water demands we must continue to plan and act on a future with less water.

Water for Victoria is the Victorian Government's strategic plan for the management of water resources, responding to the pressures of climate change and population growth, and doing more with less water. *Water for Victoria* highlights the importance of rigorous water accounting and a strong compliance framework so that water is only taken within sustainable limits and this is publicly reported to support community confidence.

Central to Victoria's water accounting and compliance framework is a sophisticated system of metering usage, gauges on rivers to monitor flows, and observation bores to determine groundwater levels in aquifers. Victoria's Water Register records water usage to ensure individual use is permitted and to monitor that water is taken within sustainable limits.

The annual *Victorian Water Accounts* utilises this data from the Water Register to publicly report on how much water was available during the year, and how much was used between the different demands in accordance with Victoria's framework for allocating our scarce water resources.

Victoria experienced drier than average conditions across the state as 2018 drew to a close. Likewise, the *2016–2017 Victorian Water Accounts* show that overall the water year ended with the driest June on record for Victoria. This contrasted with the start of the 2016–17 water year with average to above average rainfall over winter and spring of 2016, maintaining healthy streamflows. As a result, there was over double the amount of surface water available in 2016–17 compared to 2015–16.

In 2016–17, most of Victoria received very much above-average rainfall during September, including the north and west of the state, where rainfall was the highest on record. As a result, there was significantly more streamflow, with Victoria's total streamflows for the year reaching 118% of the long-term average.

The Victorian Water Accounts show the volume of surface water, groundwater and recycled water available in 2016–17 was 32,239,118 ML, compared to 14,255,141 ML in the previous year. Of the water available, 3,633,465 ML of water was taken for consumptive purposes, compared to 4,398,170 ML taken in 2015–16.

In a future with less water it is even more critical that water is extracted within sustainable limits so that our precious environment is protected, water is shared fairly and the resource is managed sustainably. It is important that the *Victorian Water Accounts* tracks and publicly reports on this compliance on an annual basis as we have done for 14 years.

THE HON LISA NEVILLE

Minister for Water

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Executive summary

Victorian Water Accounts 2016–17 at a glance

- This report provides 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.
- 2016–17 was a wetter-than-average year for most of Victoria. Most of Victoria received very much above-average rainfall during September, including areas in the north and west of the state where rainfall was the highest on record.
- Despite the above-average rainfall in spring, rainfall for June 2017 was very much below average, with the driest June on record overall for Victoria.
- The total available volume of surface water, groundwater and recycled water was higher than in the previous year.
- The increased rainfall meant there were fewer restrictions in 2016–17. Water use was restricted for fewer urban and rural users, with one town and 76 rivers affected.
- All high-reliability entitlements received 100% allocation in regulated systems.
- Almost all storage levels ended the year higher than they began it. Surface water consumption decreased from the previous year.
- In most groundwater systems, water levels stabilised and groundwater use decreased, compared to 2015–16.
- Recycled water use decreased, compared to 2015–16.
- This year was the Victorian Environmental Water Holder's sixth year managing water for the environment across the state. In 2016–17, 98% of identified potential watering actions were fully or partially achieved through a combination of naturally wet conditions and managed environmental flows. This is the highest proportion of actions the VEWH has achieved since it started.

About the *Victorian Water Accounts 2016–17*

The *Victorian Water Accounts 2016–17* is the fourteenth 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 2016 and 30 June 2017. 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 2016–17* 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 2016–17* 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.

Wetter conditions across Victoria

2016–17 was a wetter-than-average year for most of Victoria. Overall the north and west received average to above-average rainfall and the east received average or below-average rainfall. Rainfall in winter 2016 was above the 30-year average for much of Victoria, except for in the north-west where rainfall totals tended to be average. In 2016, Victoria experienced the tenth-wettest spring on record. It was the wettest spring since 2010 and the coolest spring since 2003. Summer rainfall was generally close to average in most of Victoria, with above-average rainfall in some patches along the South Australian border and in the north-east, and rainfall was below average in the south-east and in East Gippsland. Although autumn rainfall was close to the long-term average for Victoria, June 2017 was the driest June on record overall for Victoria since records began in 1900. This continued a run of six consecutive autumn seasons of drier-than-average conditions in the state.

Across most of the state, evapotranspiration represented a smaller-than-average proportion of rainfall, with more rainfall flowing into streams and recharging groundwater aquifers than would be the case in an average year. As a result of high rainfall and low evapotranspiration, significantly more rainfall remained for streamflows, with Victoria's total streamflows for the year reaching 118% of the long-term average.

There were fewer restrictions in 2016–17 than in 2015–16, with only one town affected (compared to 35 in 2015–16) and 76 streams (compared to 157 streams in 2015–16). All high-reliability entitlements received 100% allocation in regulated systems, compared to two systems in 2015–16.

In groundwater catchments, water level trends stabilised in 14 of the groundwater management units that were declining in 2015–16.

Increased water availability

A total of 32,239,118 ML of surface water, groundwater and recycled water was available in 2016–17. This is more than double the 14,425,141 ML available in 2015–16. The increase in available water was mainly due to increased surface water volumes, attributable to above-average rainfall conditions.

Victoria's total storage levels started the year at 6,779,291 ML (55% of capacity) and ended at 8,331,421 ML (67% of capacity). The storages remained above the low levels experienced during the driest years of the past decade; and for the first time since 2011–12, the regional storages ended the year higher than they began.

In contrast to 2015–16 when lower allocations were received, all high-reliability entitlements in all systems received 100% allocation in 2016–17. In northern Victoria, the Bullarook, Campaspe and Broken systems reached 100% allocation for low-reliability entitlement, and for the first time since their creation, low-reliability water shares in the Murray system reached 5% in February 2017. In southern Victoria, the Thomson–Macalister district received a 20% allocation against low-reliability entitlement and the Werribee and Bacchus Marsh districts received a 75% allocation for low-reliability entitlement. Allocations for the Wimmera Mallee Pipeline Product began with initial allocations of 0% which then reached and remained at 100% after February 2017. In the Coliban Rural system, entitlement holders had access to 100% of their entitlement for the entire year.

Decreased water use

In Victoria, 3,633,465 ML of surface water, groundwater and recycled water was taken for consumptive use in 2016–17. This volume represents about 11% of the total water available during the year, lower than the 31% in 2015–16.

Surface water use was 3,197,982 ML in 2016–17, compared to 3,845,196 ML in 2015–16. A large portion of this difference was due to the above-average rainfall which kept the catchments wet and gardens watered. Less water was used for irrigation (590,802 ML less than the 2015–16 volume) and urban and commercial purposes (51,529 ML less than the 2015–16 volume).

Groundwater use also decreased in 2016–17, with Victorian water users extracting 351,672 ML of groundwater in 2015–16, compared to 457,374 ML in 2015–16.

Recycled water use decreased from the previous year, with 83,811 ML taken in 2016–17, compared to 95,600 ML in 2015–16.

In 2016–17, the Victorian Environmental Water Holder oversaw the delivery of 716,482 ML of water to 76 river reaches and 51 wetlands, and 98% of identified potential watering actions were fully or partially achieved. This was less sites and more actions than in 2015–16. Fewer wetlands and reaches were actively watered in 2016–17 compared to the previous three years, because the objectives for many waterways were met by natural flows.

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 2016–17

Part 1 of the *Victorian Water Accounts 2016–17* 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 below. 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:

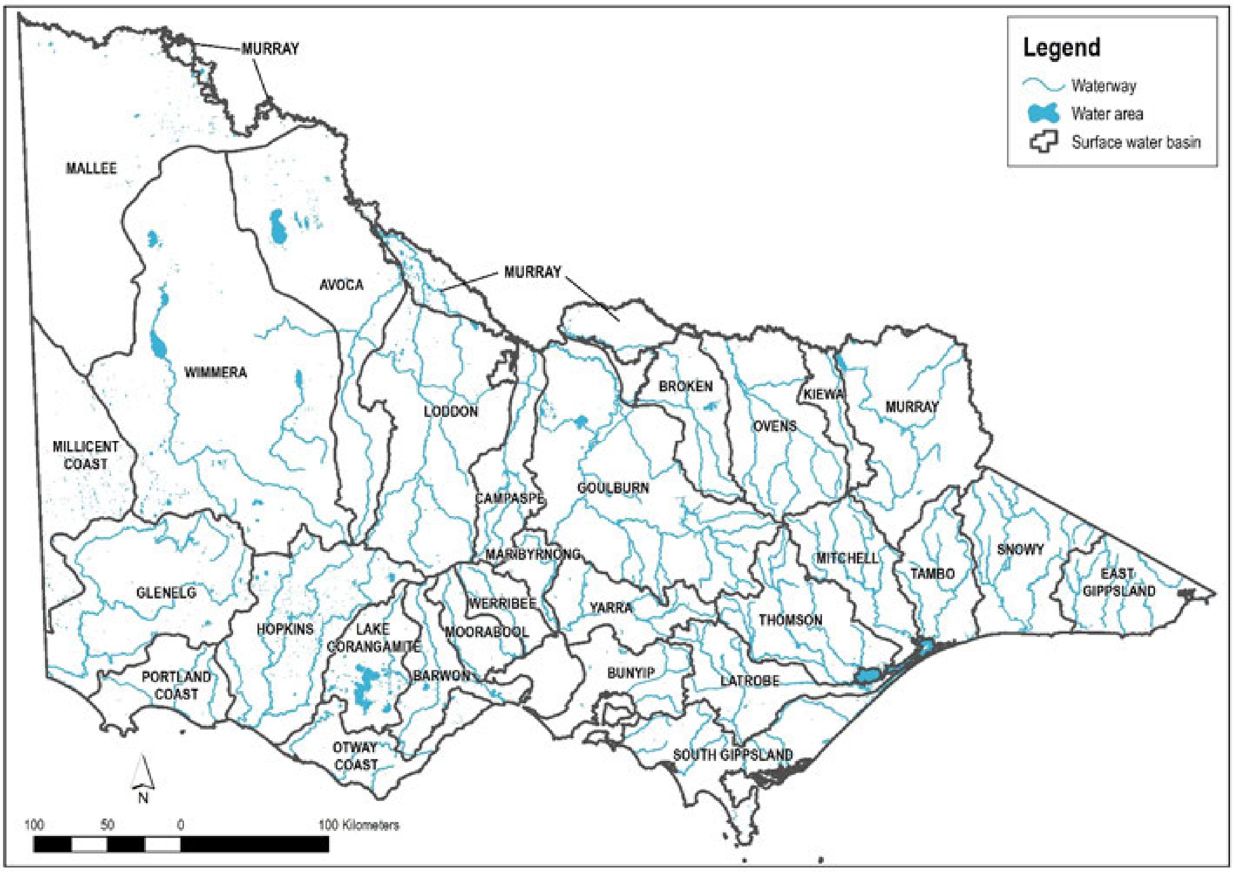
- **surface water**, which is water that occurs or flows on land. This includes water in waterways and in lakes, reservoirs, dams, wetlands and other water bodies. The term 'waterway' means a river, creek, stream, watercourse or a natural channel where water regularly flows, whether or not the flow is 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 runoff, 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 runoff 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.

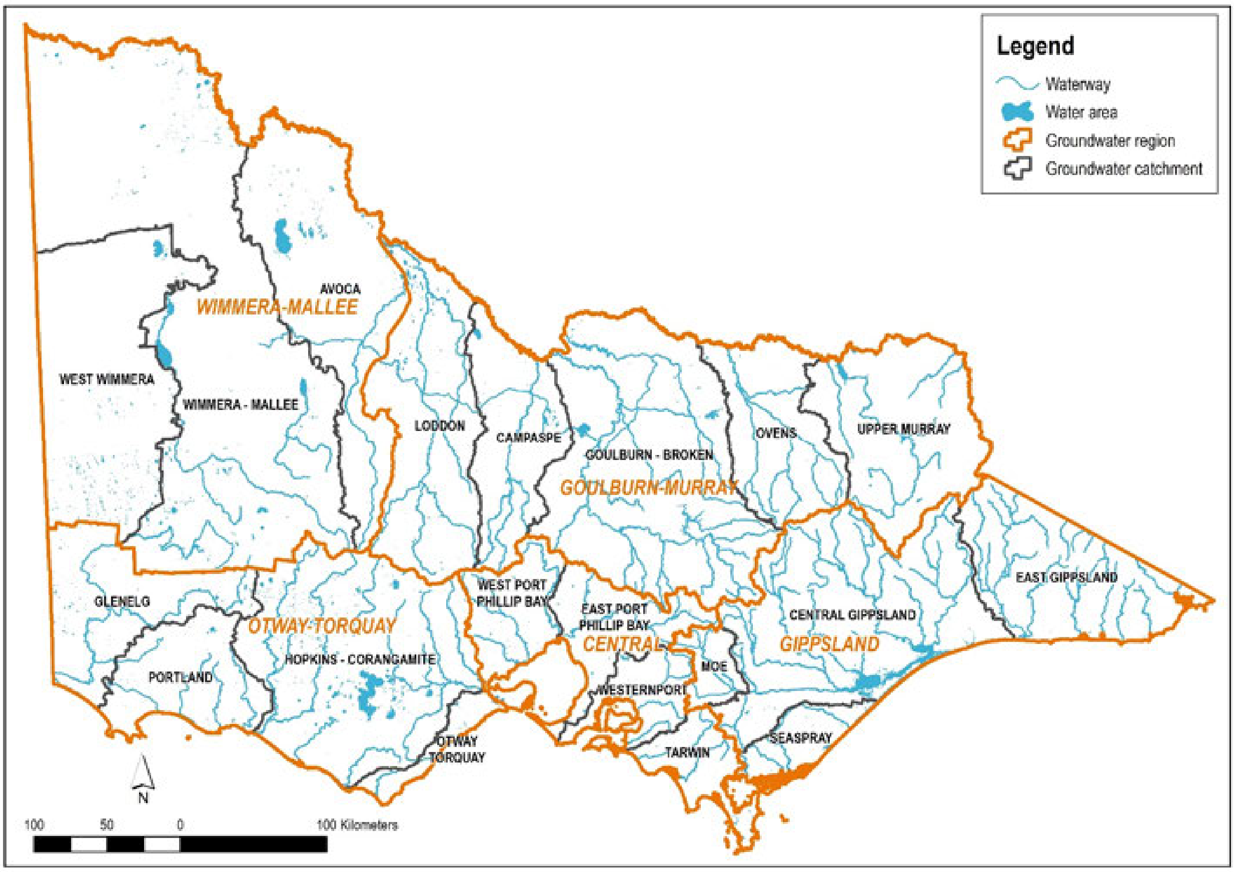
1.1.2 Groundwater

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 2016–17 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 2016–17.

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.

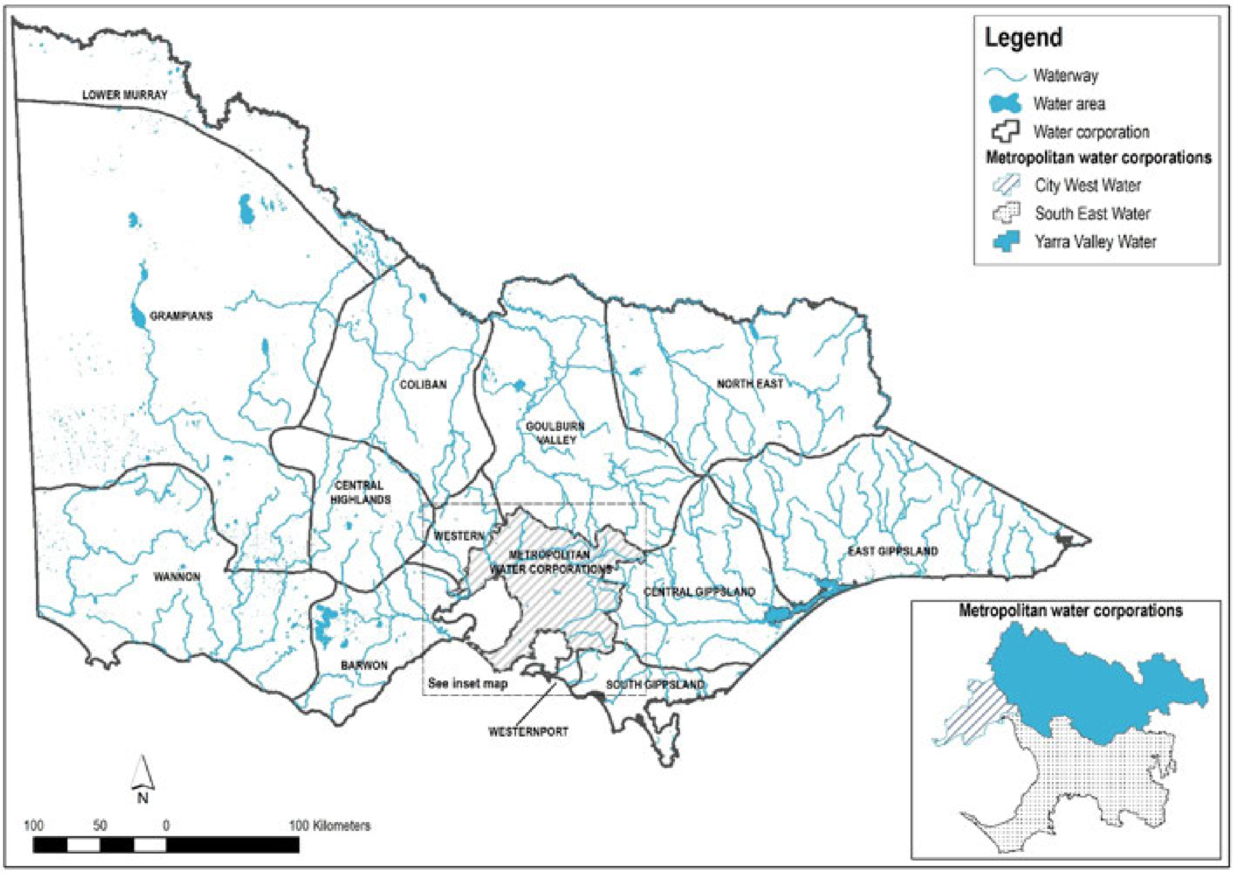
Sixteen **water corporations** provide urban water supply (including of recycled water) and sewage and trade waste disposal services to urban customers throughout Victoria. Figure 1-3 shows their areas. In regional Victoria, they are:

- 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



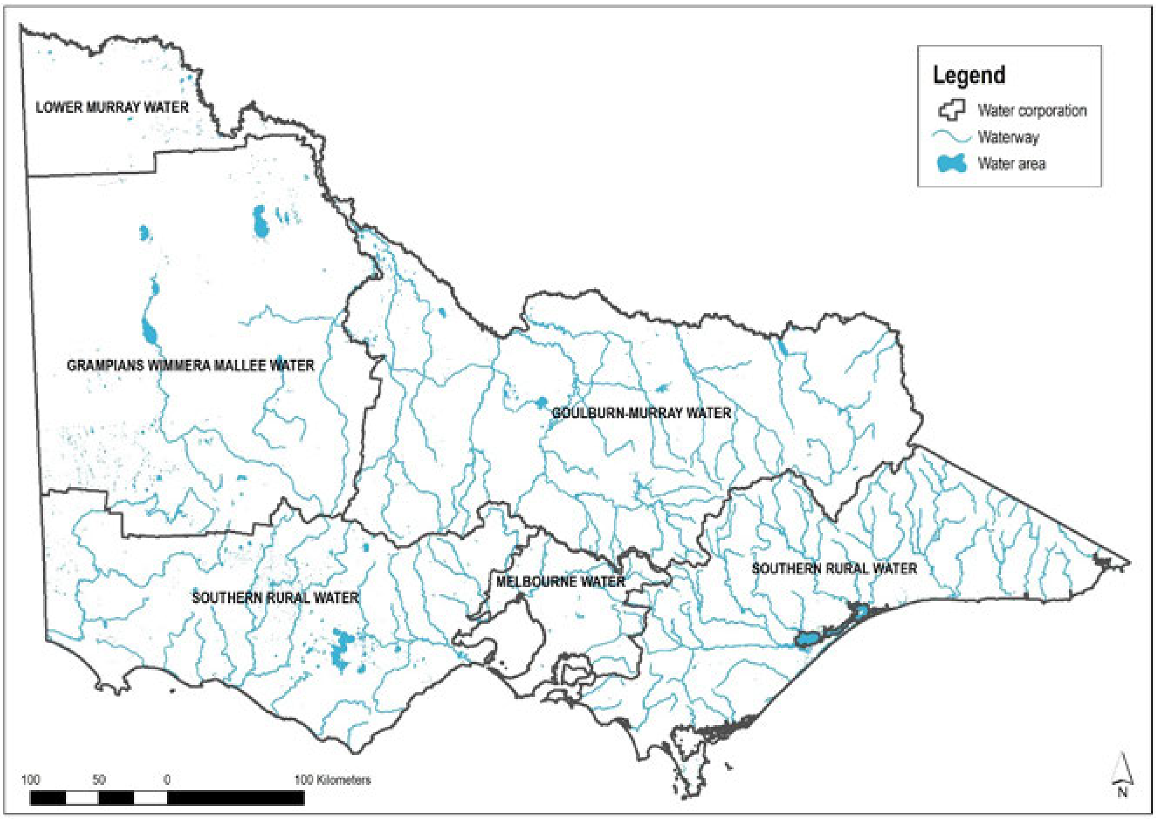
Six **rural water corporations** provide rural water services, including water supply, drainage, and salinity mitigation services for irrigation and domestic and stock purposes. They are:

- 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:

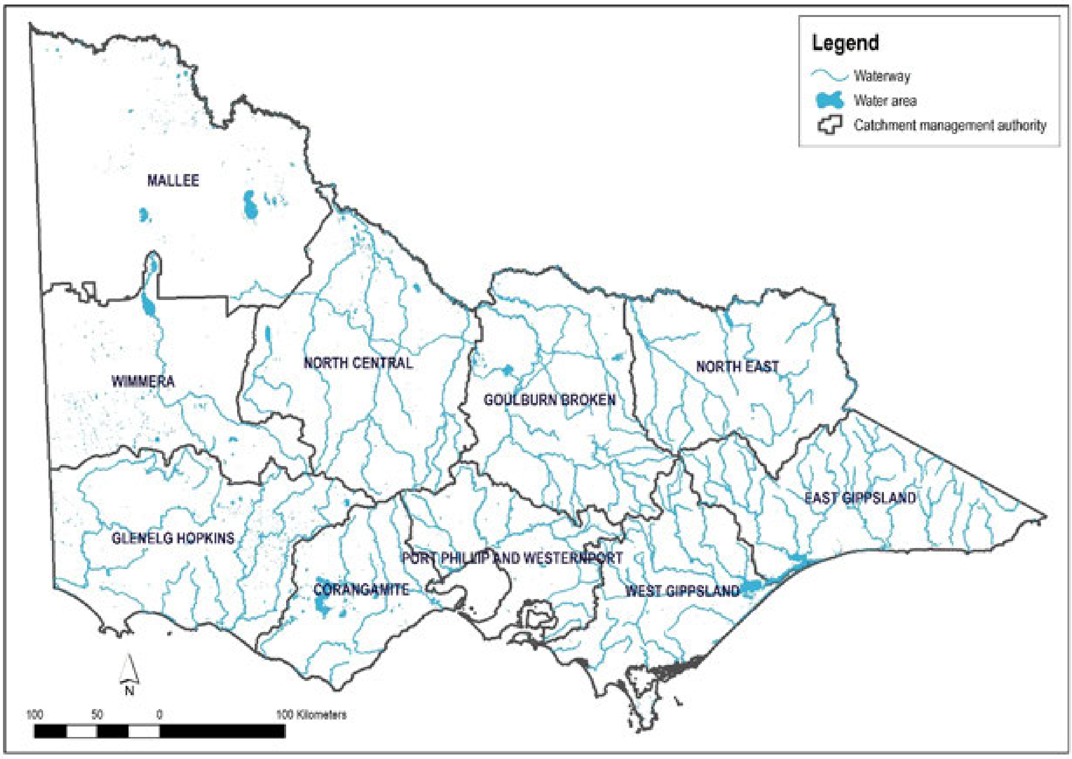
- managing rivers, creeks and major drainage systems in the Melbourne, Port Phillip and Western Port areas
- developing and implementing management plans on behalf of the Minister
- administering the diversion of water from waterways
- suppling recycled water, through a number of retail water corporations, 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 10 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 **Victorian Environmental Water Holder** (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:

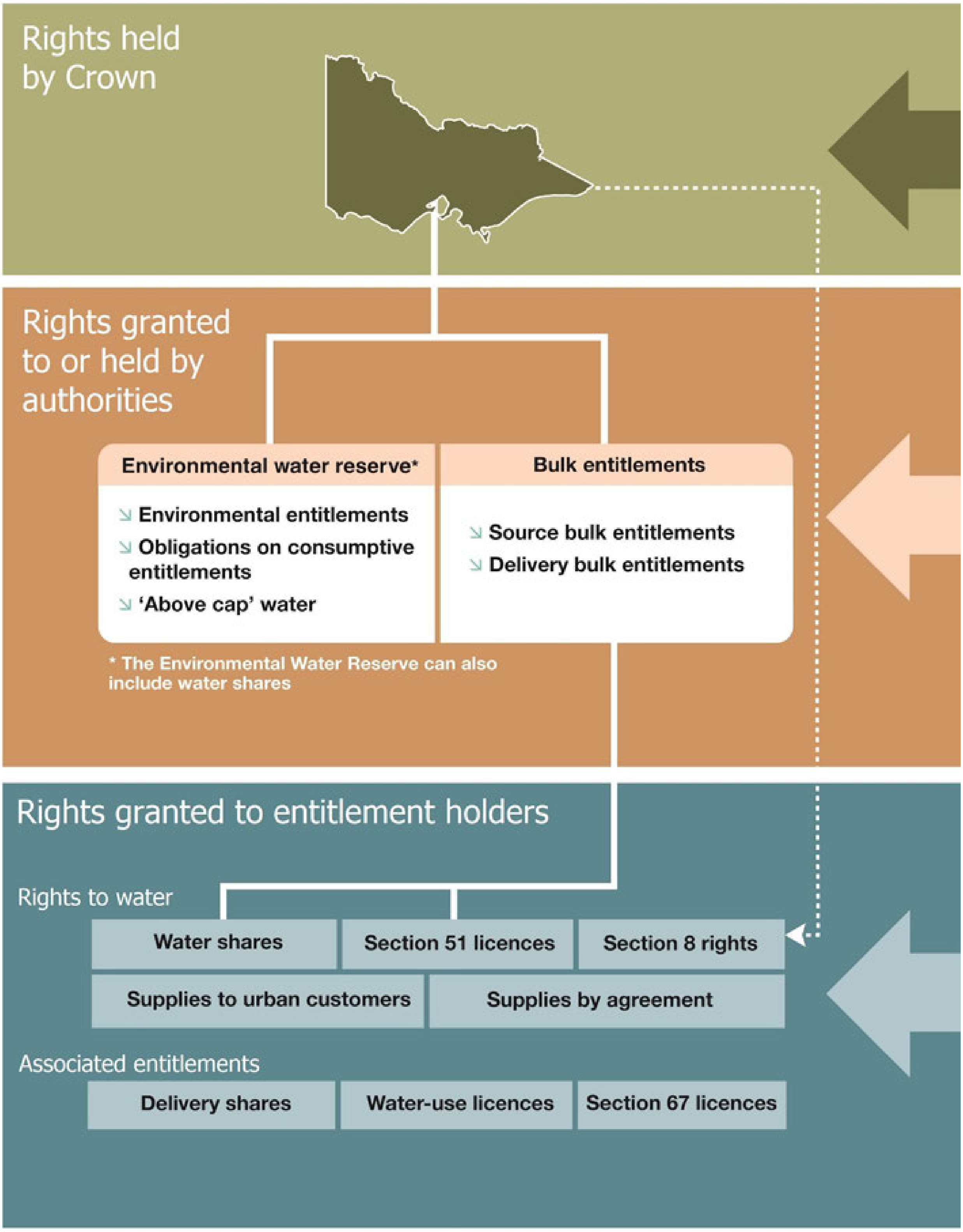
- secure entitlements with tenure that is certain and protected including bulk entitlements, environmental entitlements, water shares, take and use licences and contractual agreements to supply
- limits on water entitlements: that is, specified volumes, extraction rates and locations, diversion rules 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 water security outlooks in urban systems
- local planning to balance the demand of water and available supply in urban areas
- 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 every 7 to 10 years
- long-term water resource assessments of the resource base and river health every 15 years.

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 Act, 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 2016–17.

Environment entitlements are a right to water granted to the Victorian Environmental Water Holder 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 (RWCs) are responsible for managing regulated and unregulated systems.

In regulated water systems, RWCs 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. 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 catchments**: the longitudinal flow path of connected groundwater resources, which are interconnected laterally within a region.
- **groundwater management units (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

- **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 2016–17 (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 toward management on a catchment scale to reflect connected resources, reduce costs and achieve better environmental outcomes.

Lessons from the Millennium Drought

Between 1997 and 2009, 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, sustainable water strategies)
- 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 framework includes 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 2016–17 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 2016–17.

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 2016–17.

1.3.2.1 Urban water restrictions

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 2016–17.

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.

GMW 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 2016–17 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 2016–17.

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 2016–17.

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 (SOBN) 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 2016–17. 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 2016–17. 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 2016–17.

There were some key changes to water availability in 2016–17, compared to the previous year:

- most of Victoria received very much above-average rainfall during September, including areas of highest-on-record rainfall in the north and west of the state (Chapter 2.1)
- June 2017 rainfall was the lowest on record since measurements began in 1900
- there were no La Niña or El Niño events in 2016–17 (Chapter 2.1)
- overall, 118% of long-term annual average streamflows were received in Victoria, with 24 of 29 river basins receiving higher annual streamflow volumes than those received in 2015–16 (Chapter 2.2)
- by November 2016, 31 of Victoria's regional storages reached at least 90% of capacity, and 11 reached full capacity and were spilling (Chapter 2.3)
- groundwater levels stabilised in 14 of the groundwater management units that were declining in 2015–16 (Chapter 2.4).

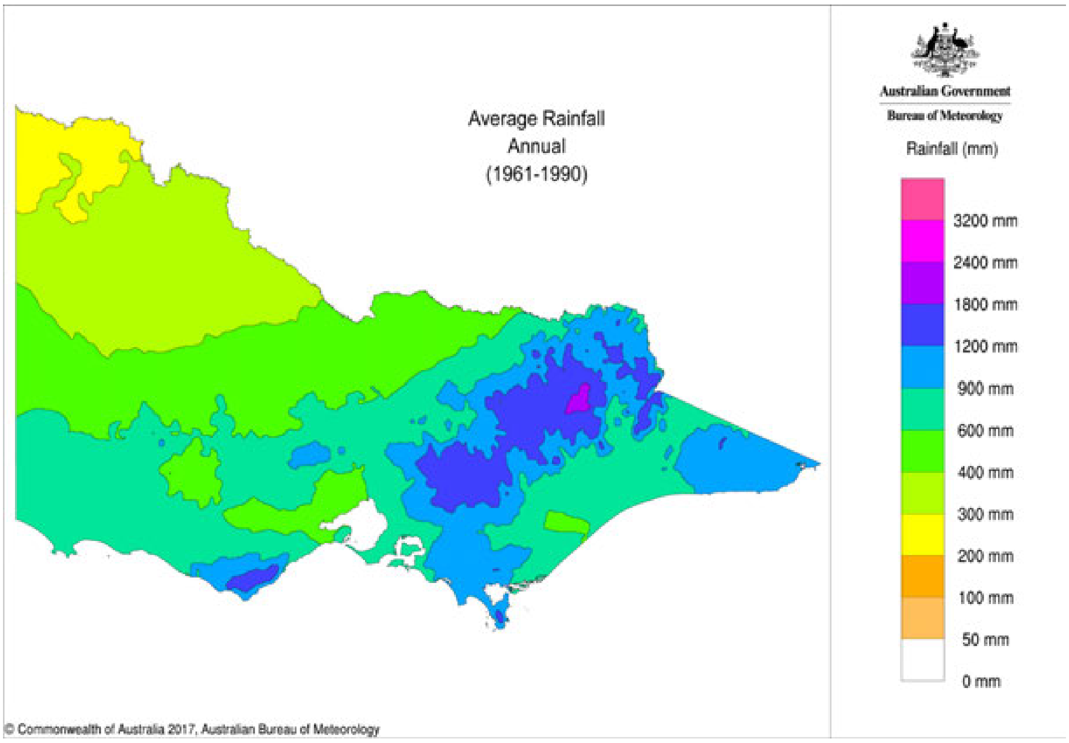
There were fewer restrictions and increased allocations in 2016–17:

- only one town was on urban water restrictions in 2016–17, compared to 35 in 2015–16 (Chapter 2.5.1)
- all high-reliability entitlements received 100% allocation in regulated systems, compared to two systems in the previous year (Chapter 2.5.2)
- there were 76 streams subject to restrictions in March 2017, compared to 157 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)



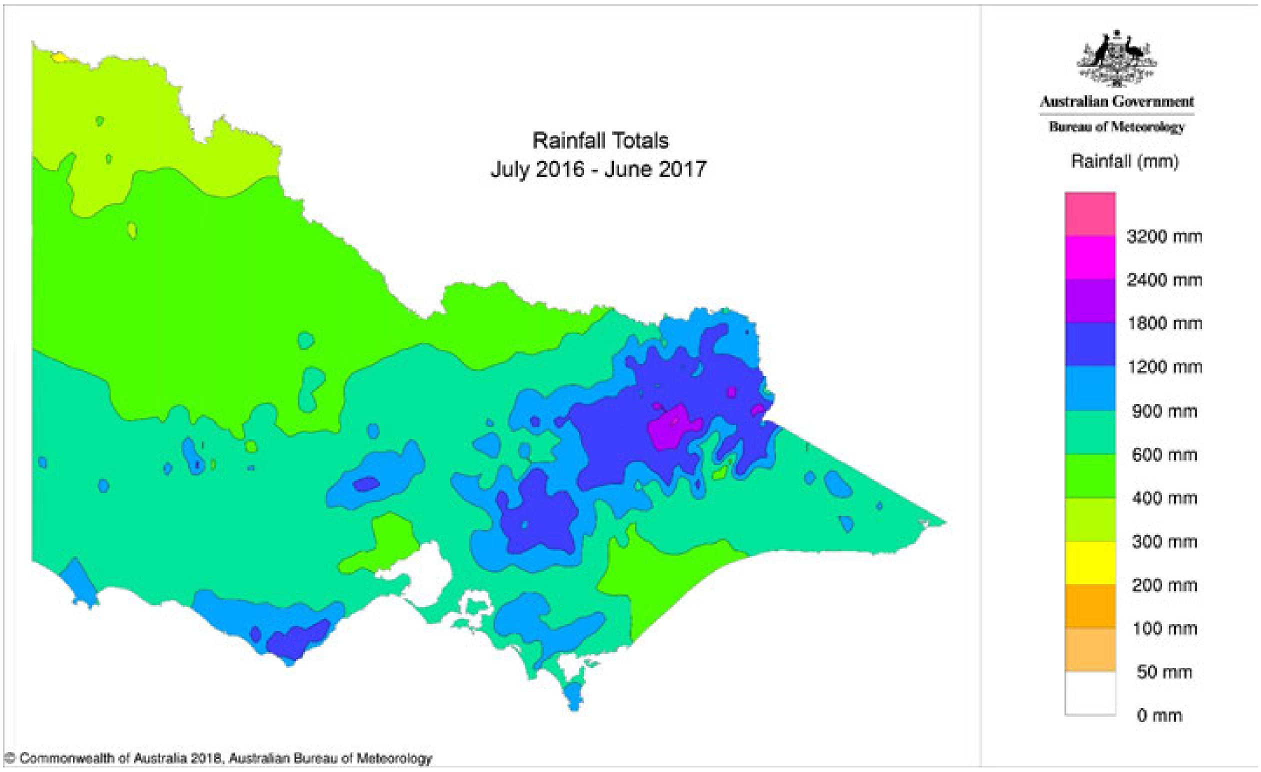
Although the 1961–1990 long-term average is used throughout the accounts, the Millennium Drought highlighted that planning and management cannot assume that climate will always remain the same (Chapter 1.3.2). Victoria's climate has shown a warming and drying trend over recent decades, and this trend 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 BoM to incorporate the climate trends from the last two decades into a new assessment of the current climate.

In contrast to the below-average rainfall received in most of Victoria in 2015–16, rainfall in 2016–17 was average and above average across most of the west and north of the state and average or below-average in the east. The range for total annual rainfall varied from 300 to 600 mm in the north-west, from 600 to 900 mm in the south-west, up to 1,800 mm in some areas along the south-west coast and east Gippsland, and from 900 to 2,400 mm in the Alpine area (Figure 2-2).

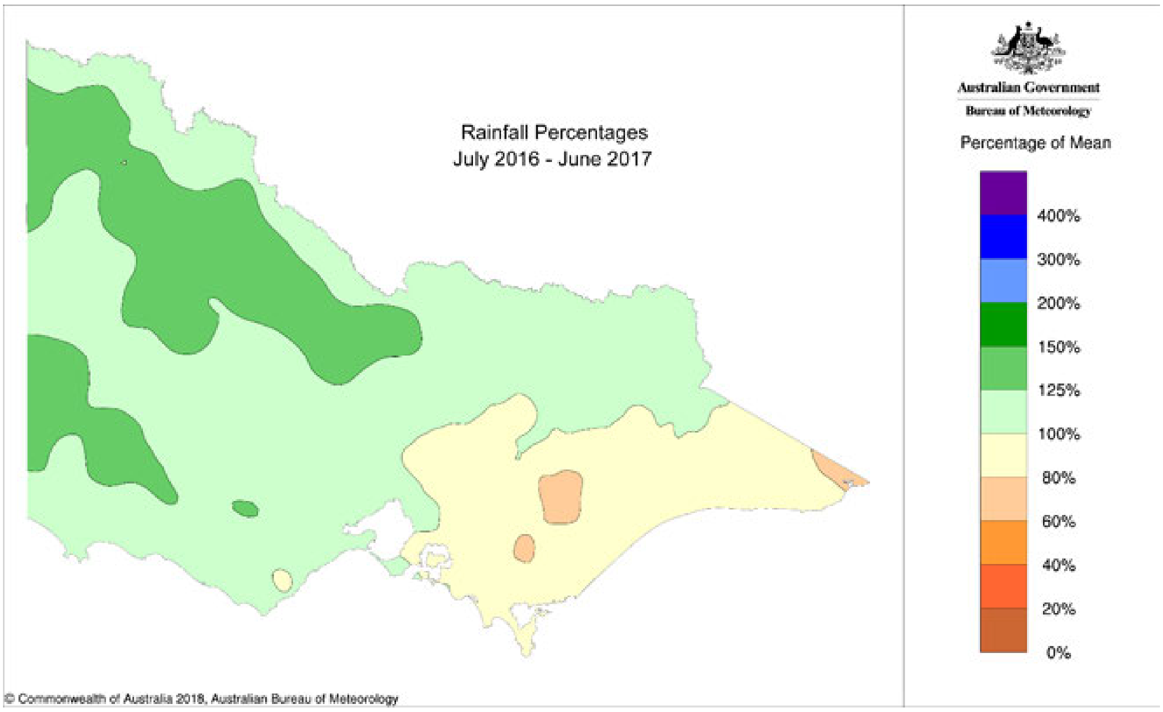
Figure 2-2 Victorian rainfall, 2016–17, millimetres



In 2016–17 between 100 and 125% of average rainfall was received in most of the west and north-east of Victoria, with some parts of the west and north-west receiving up to 150%. The south-east and East Gippsland generally received 80%–100% of the long term average, with some areas near Lakes Entrance, Mallacoota and the Yarra Ranges only receiving 60%–80% of the long-term average (Figure 2-3). Temperatures were also above average for most of the state during 2016–17, except in spring when Victoria experienced its coolest spring since 2003.

Average and above-average rainfall across the state was reflected in the statewide evapotranspiration rate, which was 582 mm in 2016–17. This is about 7% more than the long-term average evapotranspiration rate (1961–90). The difference between the long-term average and modelled evapotranspiration for 2016–17 was greatest in the north-west of the state, where evapotranspiration was up to 20% higher than the long-term average. In the far south-east of the state, the evapotranspiration estimates were closer to the long-term average. Across most of the state, evapotranspiration represented a smaller-than-average proportion of rainfall. As a result, more rainfall flowed into streams and recharged groundwater aquifers than would be the case in an average year (Appendix A).

Figure 2-3 Victorian rainfall, 2016–17, as a percentage of long-term average rainfall



Rainfall during winter 2016 was above the 30-year average for much of Victoria, except for the north-west where rainfall totals tended to average (Figure 2-4A). Temperatures were generally warmer for most of the state, except the north-west.

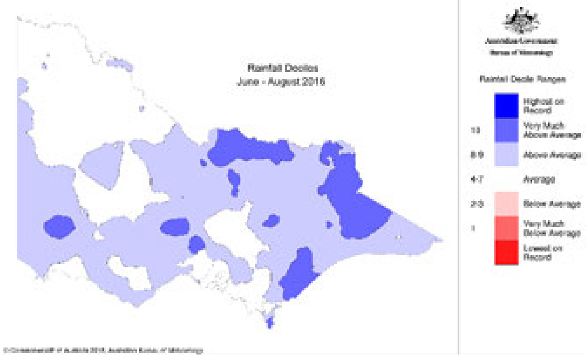
In 2016, Victoria experienced the tenth-wettest spring on record. It was the wettest spring since 2010 and the coolest spring since 2003 (Figure 2-4B). For most of western Victoria and near the border in the north-east, rainfall was very much above average and temperatures were cooler than average. Daytime temperatures were particularly cool in the north and west of the state during September and October. Most of the rest of the state received above-average spring rainfall, except for an area of below-average rainfall around the western Latrobe Valley and the far east corner of Victoria. Temperatures in the far-east of Victoria were also warmer than usual in spring.

Average daytime temperatures were warmer than usual in most parts of Victoria during summer 2016–17, with most nights warmer than usual, except for in February. Summer rainfall was generally close to average in most of Victoria, with above-average rainfall in some patches along the South Australian border and in the north-east (Figure 2-4C). Most of the south-east and East Gippsland received below-average rainfall, with some areas around the Gippsland Lakes receiving their lowest total rainfall on record. December contributed most of the near-average rainfall in summer, when much of it fell on the afternoon of the 30th, delivering the highest summer daily rainfall on record for many areas and triggering flash flooding. Extremely high rainfall intensities occurred at a number of locations during the event. One significant example was in Melbourne, when heavy rain fell in many northern, eastern and south-eastern suburbs, causing localised flash flooding. A number of sites in the Alpine area had daily totals exceeding 100 mm, with the highest total of 158.6 mm at Mount Hotham.

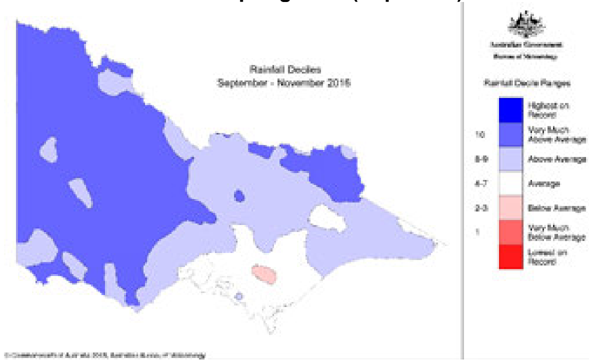
Despite the above-average rainfall in September, autumn rainfall totals were near average across the state (Figure 2-4D), and mean daytime and overnight temperatures were warmer than usual. June 2017 was also the driest June on record since measurements began in 1900 for large areas of inland north and north-eastern Victoria.

Figure 2-4 Victorian seasonal rainfall deciles, 2016–17

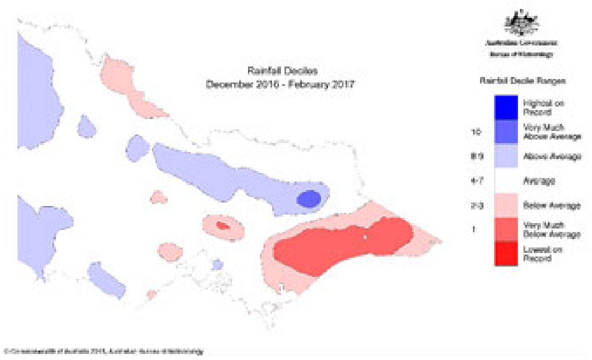
A. Rainfall deciles for winter 2016 (June–Aug)



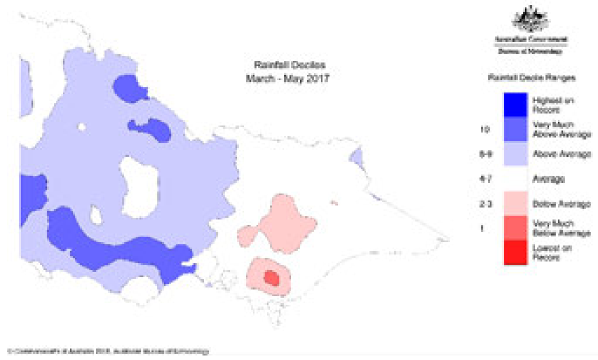
B. Rainfall deciles for spring 2016 (Sept–Nov)



C. Rainfall deciles for summer 2016–17 (Dec–Feb)

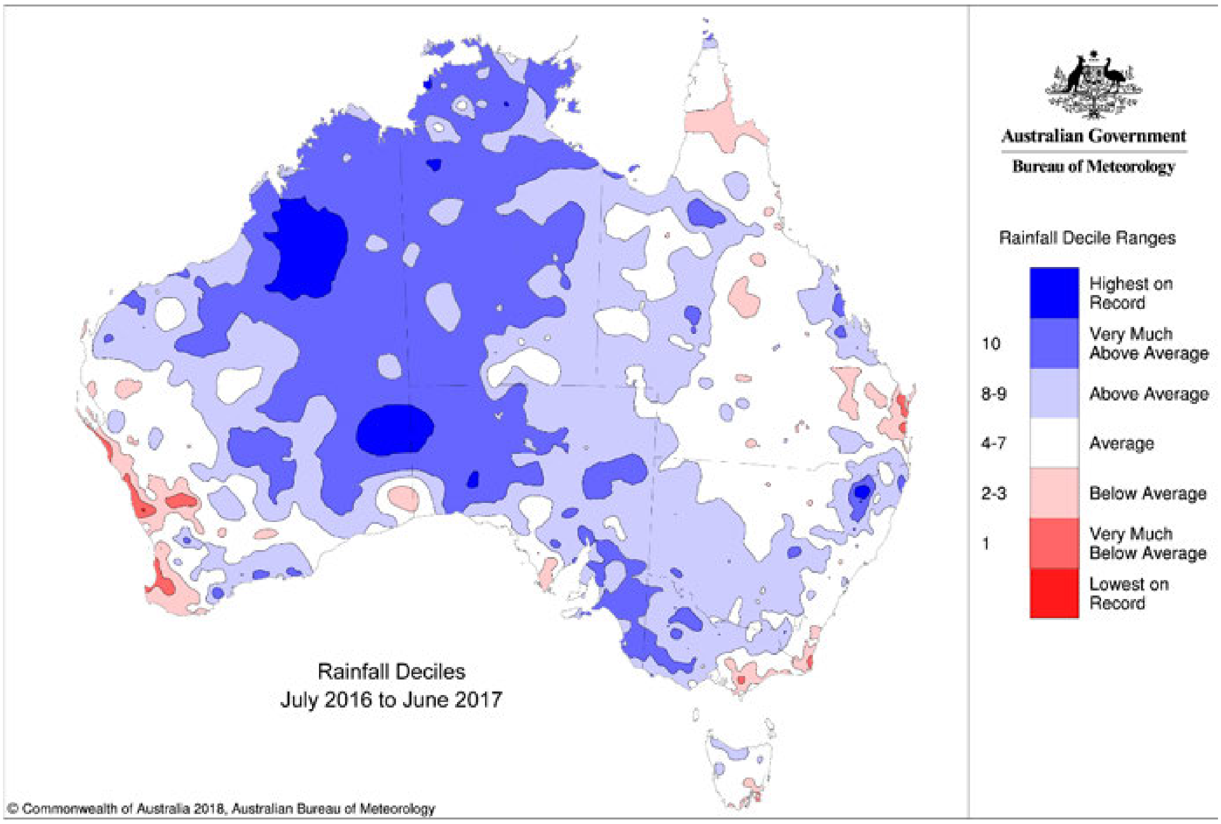


D. Rainfall deciles for autumn 2017 (Mar–May)



Overall, the north and west of Victoria received average to above-average rainfall in 2016–17 with the east receiving average or below-average rainfall. A similar trend was observed in Queensland and the coastal regions of Western Australia. The other states generally received above or very much above-average rainfall, with parts of Western Australia and South Australia receiving the highest rainfall on record (Figure 2-5).

Figure 2-5 Australian rainfall deciles, 1 July 2016 to 30 June 2017



There were no El Niño or La Niña events in 2016–17. The tropical Pacific Ocean remained in a neutral El Niño – Southern Oscillation (ENSO) state — neither El Niño nor La Niña for most of the year. From April to November 2016, the BoM issued a La Niña watch, which reverted back to ENSO-neutral in December. The BoM then issued an El Niño watch as the tropical Pacific Ocean started to warm up in February 2017. This was in place until late June 2017, when the early-autumn warming reversed in the eastern tropical Pacific Ocean and the outlook was reset to ENSO-neutral.

The Indian Ocean Dipole (IOD) entered a strong negative phase in July 2016, before returning to neutral in November 2016. A negative IOD typically results in above-average winter–spring rainfall over parts of southern Australia, as the warmer waters off north-west Australia provide more available moisture to weather systems crossing the country. This appears to have been a key driver of the relatively wet spring in 2016 across west and north-east Victoria.

2.2 Streamflow

In this report, 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.

In 2016–17, 24 of 29 river basins had annual streamflow volumes higher than those received in 2015–16 (Table 2-1). When compared to long-term annual average streamflows, 21 basins had above-average streamflows for 2016–17, compared to the previous year when 24 basins had below-average streamflows. Overall, the total annual streamflow volume for Victoria was 118% of the long-term average (Table 2-1). This is more than double the long-term average reported for 2015–16, of 50%.

As a result of the high rainfall and smaller-than-average evapotranspiration across most of the state, more rainfall flowed into streams, and this is reflected in the amount of streamflows each basin received. Although some of the usually wet basins in the east of the state (East Gippsland, Tambo and Snowy) received above-average streamflows, the majority of them had a reduction in streamflow compared to 2015–16. As shown in Chapter 2.1 above, the west and north of the state received above-average rainfall; the east of the state was drier, receiving average or below-average rainfall.

Although the Avoca basin was the driest in 2016–17 — receiving 46% of the long-term average — it actually received higher inflows than the previous year, of 13%.

The Broken basin had the biggest streamflow increase and change from the previous year, receiving 176% of long-term average streamflows in 2016–17, compared to 25% in the previous year.

The East Gippsland basin, usually one of the wettest basins, had the largest reduction in streamflows from 2015–16, receiving 83% of the long-term average in 2016–17, compared to 163% the previous year.

The basins in the west and north of the state saw large increases in streamflows received from the previous year:

- in the north, the Murray, Campaspe, Loddon, Kiewa, Ovens and Broken basins all received between 127% (Campaspe) and 176% (Broken) of the long-term annual average
- in the west, the Otway Coast, Wimmera, Corangamite, Glenelg and Portland basins received between 106% (Otway Coast) and 140% (Portland) of the long-term annual average.

Many of the driest basins in 2015–16 were also the highest-yielding basins relative to their long-term annual averages in 2016–17:

- the Mitchell basin received 120% of average streamflows, more than double the 58% received in 2015–16
- in the central and south-east basins, the Moorabool, Bunyip, Maribyrnong and Werribee basins received between 109% (Moorabool) and 126% (Werribee) of the long-term annual average.

Other basins across the state with large increases, as a percentage of long-term averages, from the previous year included:

- Goulburn basin – 94% received in 2016–17 (from 31% in 2015–16)
- Barwon basin – 93% (from 29% in 2015–16)
- Hopkins basin – 87% (from 13% in 2015–16).

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

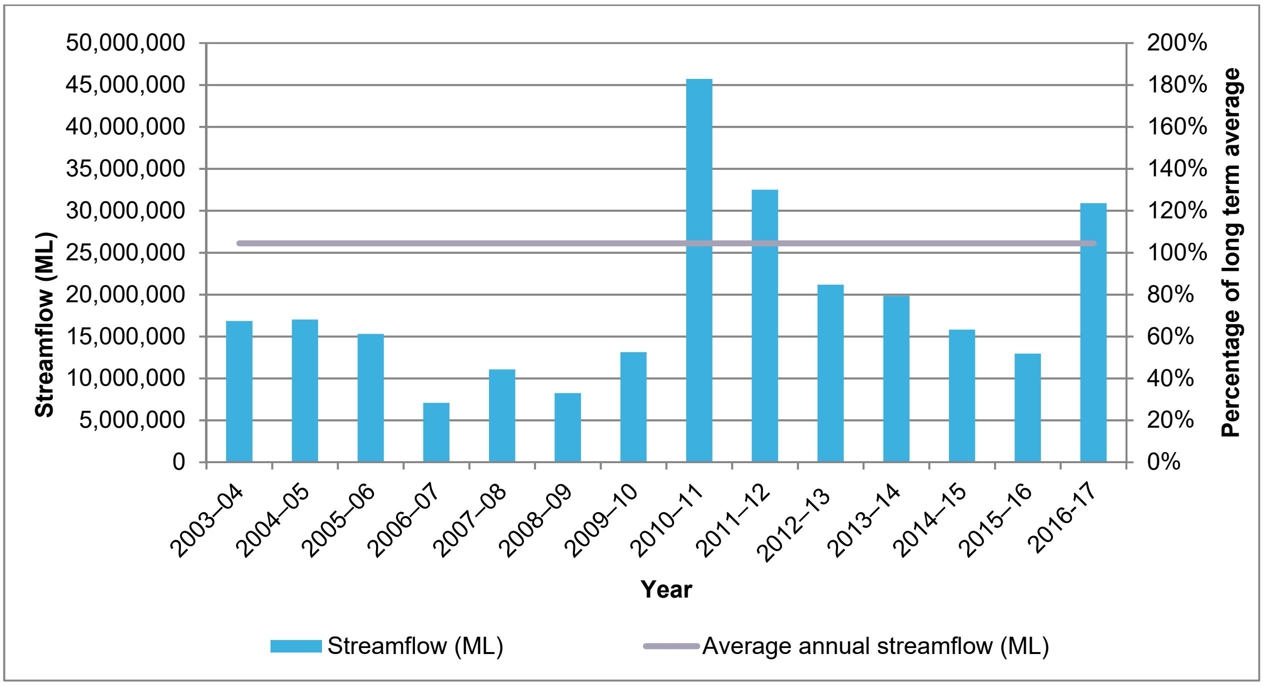
Basin	Average annual streamflow (ML)	2016–17 streamflow (1)		2015–16 streamflow (1)	
		(ML)	(% of average)	(ML)	(% of average)
Murray	7,618,000	9,837,093	129%	2,840,189	37%
Kiewa	689,000	1,092,663	159%	473,860	69%
Ovens	1,758,000	2,897,252	165%	713,835	41%
Broken	308,000	543,022	176%	77,457	25%
Goulburn (2)	3,363,000	3,170,647	94%	1,045,733	31%
Campaspe	352,000	445,441	127%	55,051	16%
Loddon	373,000	575,122	154%	79,109	21%
East Gippsland	714,000	590,896	83%	1,161,494	163%
Snowy (3)	1,022,000	1,691,959	166%	1,927,323	189%
Tambo	297,800	358,443	120%	435,656	146%
Mitchell	884,500	1,060,803	120%	514,486	58%
Thomson	1,101,760	962,204	87%	559,704	51%
Latrobe	847,400	636,930	75%	552,528	65%
South Gippsland	911,500	835,065	92%	579,308	64%
Bunyip	541,000	622,285	115%	466,417	86%
Yarra	1,054,000	751,311	71%	487,615	46%
Maribyrnong	113,000	136,646	121%	19,806	18%
Werribee	102,000	128,564	126%	21,115	21%
Moorabool	97,000	105,837	109%	23,457	24%
Barwon	360,000	335,884	93%	104,820	29%
Corangamite	316,000	388,612	123%	40,645	13%
Otway Coast	884,000	938,488	106%	419,384	47%
Hopkins	635,000	550,033	87%	80,845	13%
Portland Coast	361,000	505,276	140%	104,323	29%
Glenelg	964,000	1,336,754	139%	116,795	12%

Millicent Coast [(4)]	-	4	-	4	-
Wimmera	316,400	347,538	110%	44,378	14%
Mallee [(4)]	-	-	-	-	-
Avoca	136,200	62,597	46%	18,377	13%
Total	**26,119,560**	**30,907,414**	**118%**	**12,963,713**	**50%**

Notes

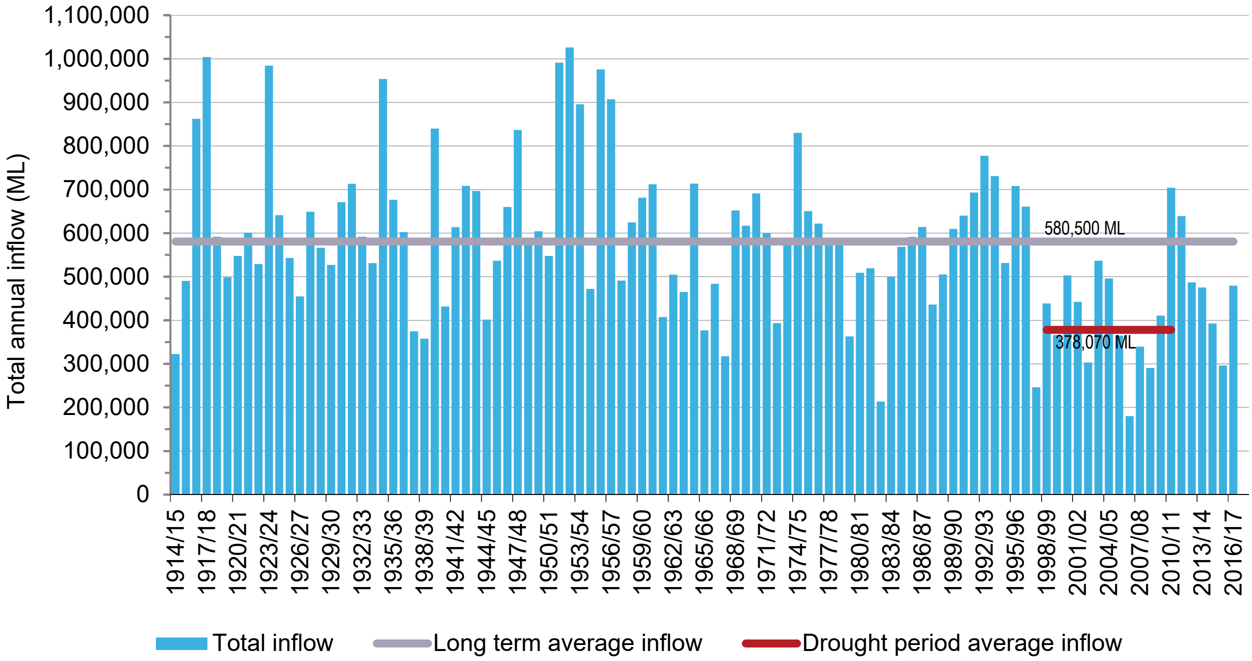
(1) 'Streamflow' is equivalent to 'catchment inflow' in the water balances presented in Chapter 6.
(2) Includes inflows from Broken River.
(3) Volumes shown for the Snowy basin exclude catchment inflows from NSW (upstream of Burnt Hut Crossing).
(4) Surface water resources within the Mallee and Millicent Coast basins are limited and there are currently no streamflow gauges in these basins. Streamflows in the Millicent 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.

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 2016–17 were the highest received since 2012–13. Although the annual inflows to Melbourne's harvesting reservoirs in the Yarra and Thomson basins in 2016–17 were below the 100-year long-term average, they were more than the average inflows of the last drought (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.

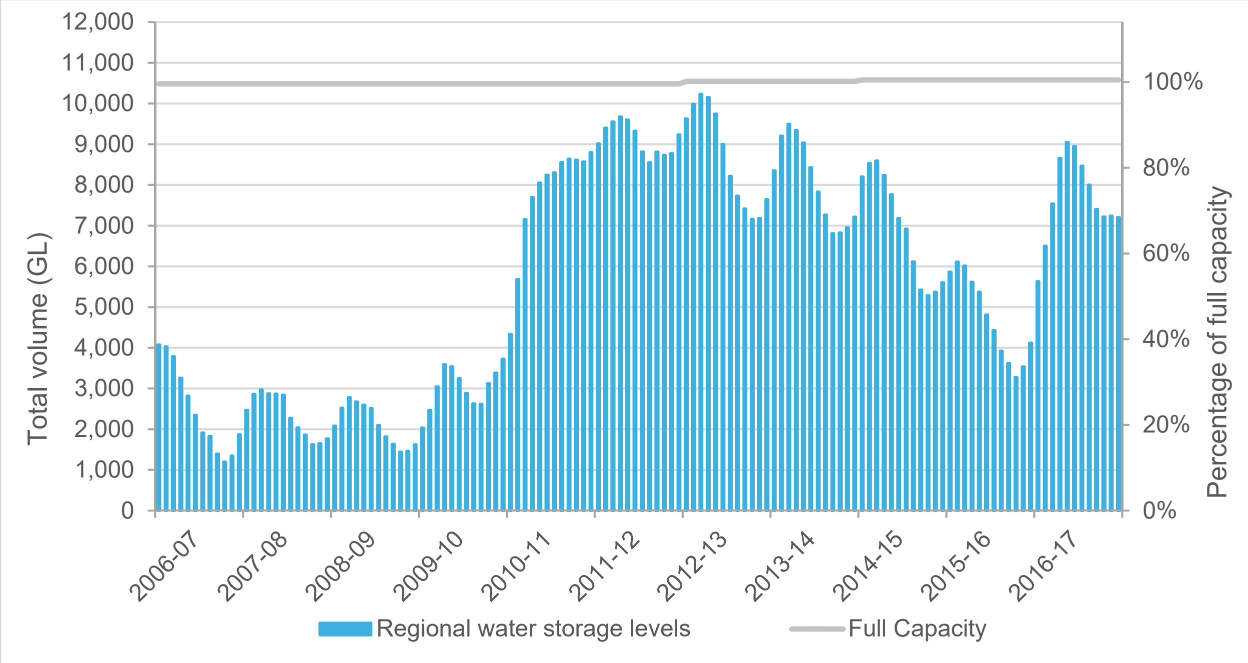
2.3 Storages

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. This data shows that in 2016–17, Victoria's total storage levels started the year at 6,779,291 ML (55% of capacity) and ended at 8,331,421 ML (67% 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 5,632,486 ML (53% of capacity) and ended at 7,204,789 ML (68% of capacity). Storage levels increased during autumn, reaching a peak of 86% of capacity in November, and declined slowly through the summer to a minimum of 68% of capacity by April 2016 (Figure 2-8). This is the first time since 2011–12 that regional water storages levels have ended the year higher than they began.

Figure 2-8 Volume in major regional water storages, 1 July 2006 to 30 June 2017 (1) (2) (3)



Notes

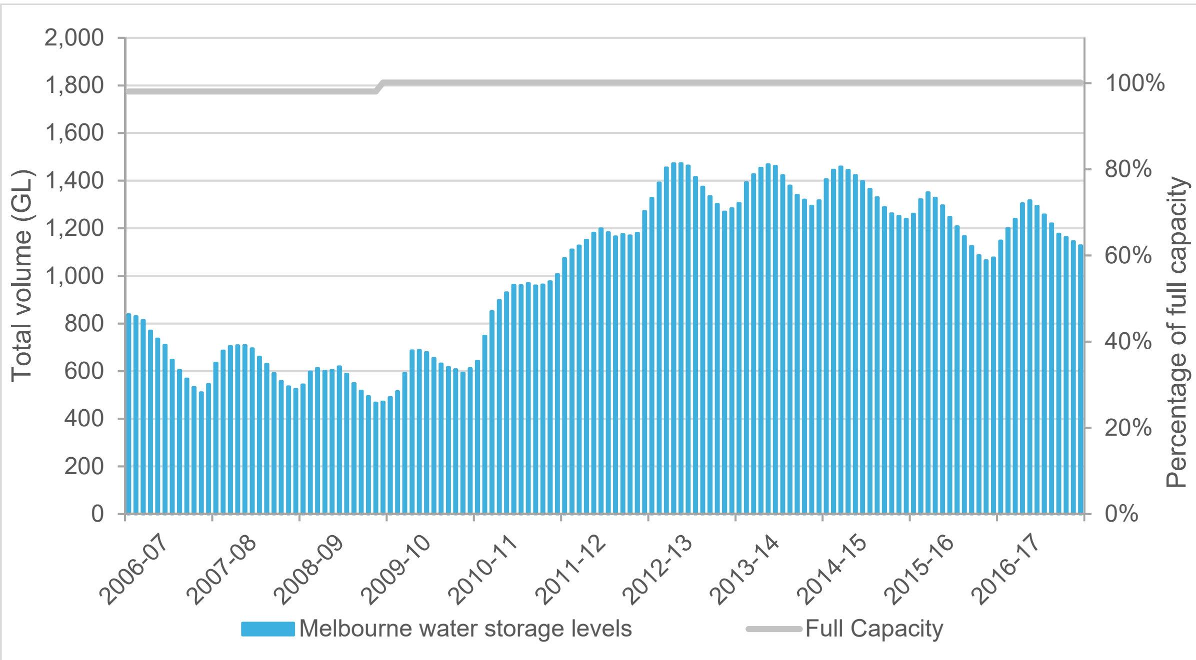
(1) The Y axis percentage relates to the current storage capacity (i.e. after the addition of the Menindee Lakes 240,000 ML in 2015–16).

(2) The mid-Murray storages have been included for the first time in the *2016–17 Victorian Water Accounts*. 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 2016–17, Melbourne's water storages started the year at 1,146,805 ML (63% of total capacity) and ended at 1,126,632 ML (62% of total capacity) after reaching a peak of 73% in November 2016 (Figure 2-9). Unlike the regional storages, Melbourne's water storages in 2016–17 followed the pattern from 2015–16 — of storage levels being lower at the end of the year than at the start of the year. 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 20 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 2004 to 30 June 2017 (1)



Note

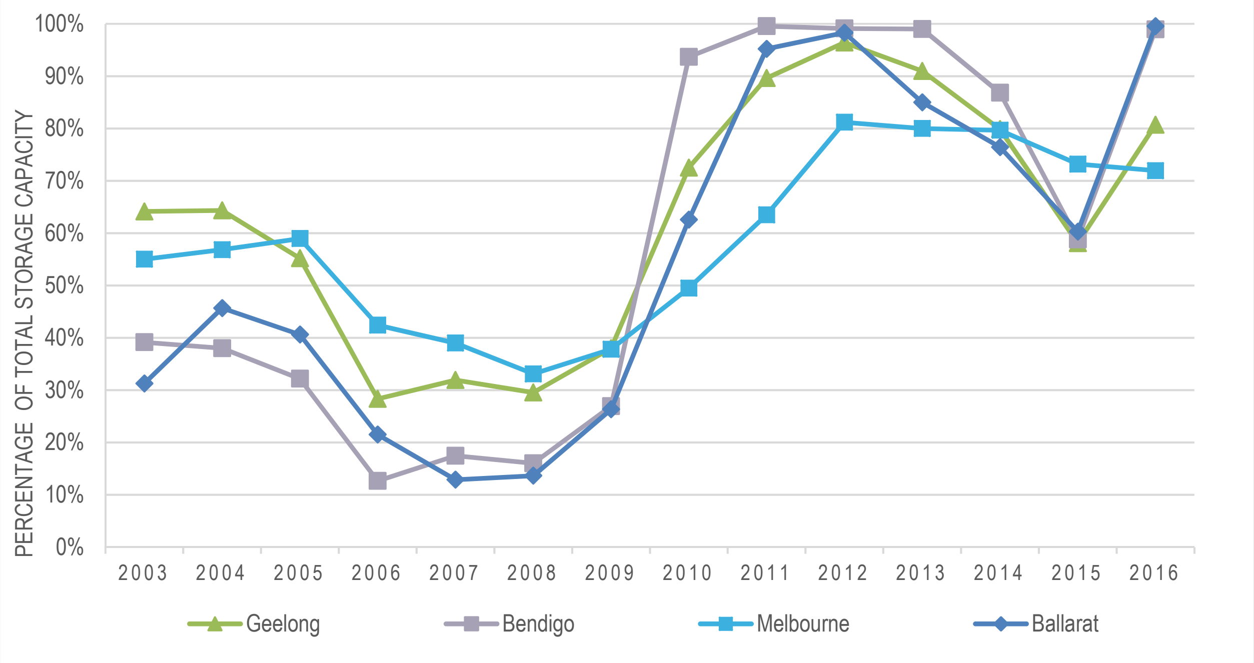
(1) The Y axis percentage relates to the current storage capacity (i.e. after the addition of Tarago's 37,580 ML in 2010).

The Victorian Desalination Project began producing water in March 2017. The total volume delivered to 30 June 2017 was 46,143 ML. This volume represents 2.55% of Melbourne's storage capacity. Without this contribution, Melbourne's storages would have ended the year below 60%. 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 2016.

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 2016, storages in Melbourne and the selected regional centres were between 72% and 100%. The regional storages were between 81% and 100%, which was on-average higher than the previous year, when regional storages were between 58% and 99%. Melbourne storages in October 2016 were at 72%, lower than the previous year when they were at 73% (Figure 2-10).

Figure 2-10 Water in reservoirs for major urban centres at the end of October, each year 2003–16, as a percentage of total storage capacity



2.4 Groundwater

Trends in groundwater levels reflect differences between the amount of water flowing into (recharge) and out of (discharge) an aquifer and how much is used for consumptive purposes. Groundwater level trends in shallow aquifers are more likely to reflect changes in recharge from either rainfall or irrigation, whereas deeper aquifer trends may show a greater influence from pumping.

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 (SOBN). 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 2016–17 stabilised more than in 2015–16. Groundwater levels in 14 GMUs that had been declining in 2015–16 were categorised as stable in 2016–17. SOBN bores were also able to be attributed to groundwater management areas (GMAs) that previously had none, and therefore for which a trend could not be determined. These included Barnawartha, Central Victorian Mineral Springs, Colongulac, Kiewa, Moorabbin, Portland, South West Limestone, Upper Goulburn and Upper Murray.

The trends in the state's water supply protection areas (WSPAs) were reversed in 2016–17, with four declining and eight stable, compared to eight declining and four stable in 2015–16 (Table 2-2 and Figure 2-11). In the state's GMAs in 2016–17, 16 were declining, compared to 20 in 2015–16, 19 were stable, compared to five in 2015–16 and as per 2015–16 two GMAs were categorised as rising 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 2016–17.

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 2016–17				Groundwater level trend June 2016
	Sep-16	Dec-16	Mar-17	Jun-17	
Central groundwater region					
Westernport groundwater catchment					
Koo Wee Rup	Declining	Stable	Stable	**Stable**	Declining
West Port Phillip Bay groundwater catchment					
Deutgam	Declining	Declining	Declining	**Declining**	Declining
Gippsland groundwater region					
Central Gippsland groundwater catchment					
Sale	Declining	Declining	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	Rising	Stable	Declining	**Declining**	Declining
Loddon groundwater catchment					
Loddon Highlands	Declining	Declining	Declining	**Declining**	Declining
Ovens groundwater catchment					
Upper Ovens	Stable	Stable	Stable	**Stable**	Stable
Otway-Torquay groundwater region					
Glenelg groundwater catchment					
Glenelg	Stable	Stable	Stable	**Stable**	Declining
Hopkins-Corangamite groundwater catchment					
Warrion	Declining	Stable	Stable	**Stable**	Declining
Portland groundwater catchment					
Condah	Declining	Declining	Declining	**Stable**	Declining
Wimmera-Mallee groundwater region					
Wimmera-Mallee groundwater catchment					
Murrayville	Stable	Stable	Stable	**Stable**	Stable

Note

(1) Yarram WSPA water levels are influenced by off-shore oil and gas extraction.

Figure 2-11 Groundwater trends in water supply protection areas

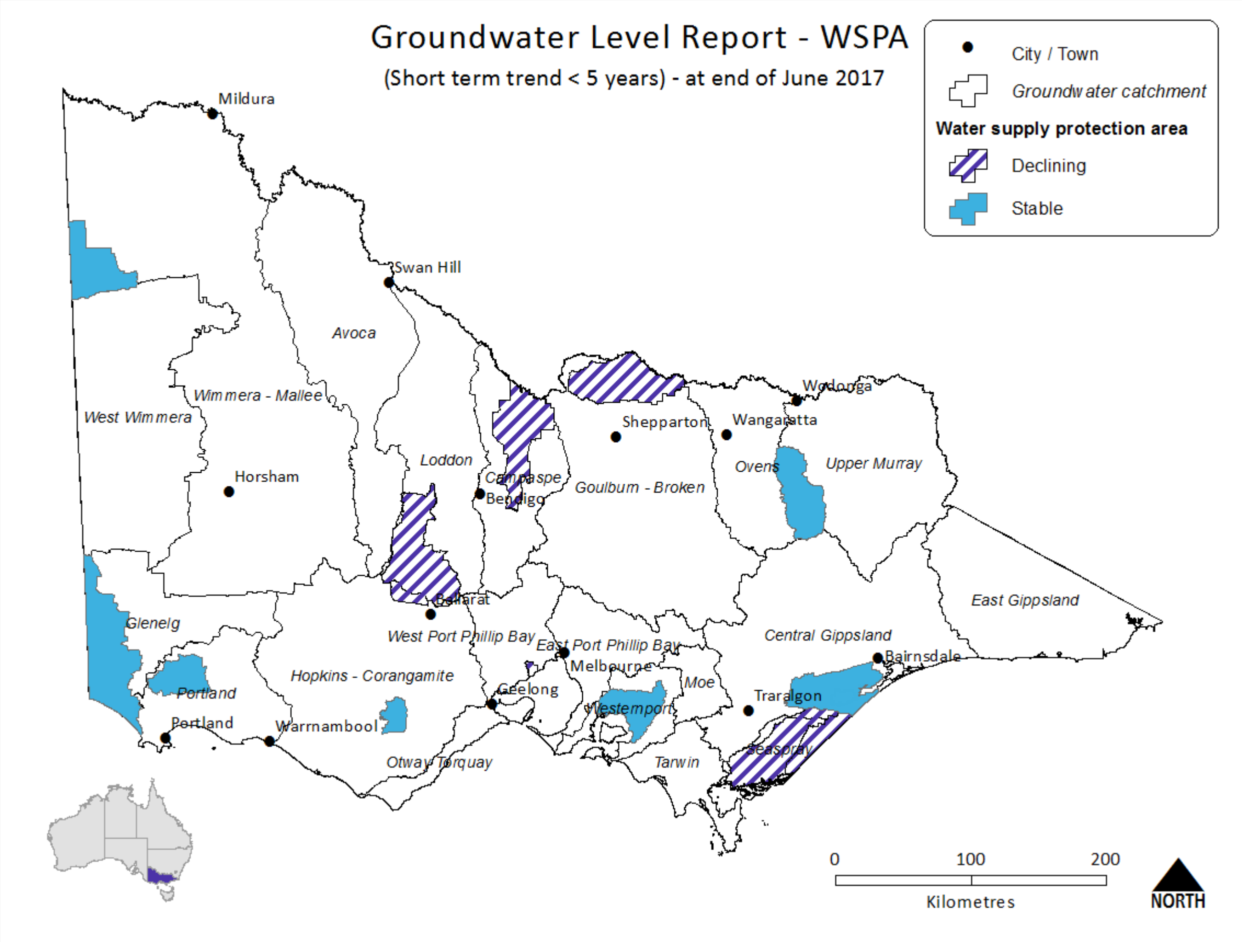


Table 2-3 Groundwater level trends in groundwater management areas

Groundwater management area [1]	Groundwater level trend 2016–17				Groundwater level trend June 2016
	Sep-16	Dec-16	Mar-17	Jun-17	
Central groundwater region					
East Port Phillip Bay groundwater catchment					
Frankston	Stable	Stable	Stable	**Stable**	Declining
Moorabbin	Declining	Stable	Declining	**Declining**	-
Nepean	Stable	Stable	Stable	**Stable**	Declining
Wandin Yallock [2]	Declining	Declining	Declining	**Declining**	Declining
Tarwin groundwater catchment					
Leongatha	Stable	Stable	Stable	**Declining**	Declining
Tarwin	Stable	Stable	Declining	**Stable**	Stable
Westernport groundwater catchment					
Corinella	Stable	Stable	Stable	**Stable**	Declining
West Port Phillip Bay groundwater catchment					
Lancefield	Stable	Stable	Stable	**Stable**	Declining
Merrimu	Stable	Stable	Stable	**Declining**	Declining
Gippsland groundwater region					
Central Gippsland groundwater catchment					
Rosedale [3]	Declining	Declining	Declining	**Declining**	Rising
Stratford [3]	Declining	Declining	Declining	**Declining**	Stable
Wa De Lock	Stable	Stable	Stable	**Stable**	Stable
Wy Yung	Stable	Stable	Stable	**Stable**	Stable
East Gippsland groundwater catchment					
Orbost	Stable	Stable	Stable	**Declining**	Declining
Moe groundwater catchment					
Moe	Declining	Declining	Declining	**Declining**	Declining
Seaspray groundwater catchment					

Giffard	Stable	Stable	Stable	**Stable**	Declining
Goulburn-Murray groundwater region					
Campaspe groundwater catchment					
Central Victorian Mineral Springs (4)	Stable	Stable	Stable	**Stable**	-
Goulburn-Broken groundwater catchment					
Broken	-	-	Stable	**Stable**	-
Mid Goulburn	Declining	Stable	Stable	**Declining**	Declining
Shepparton Irrigation	Stable	Stable	Rising	**Rising**	Stable
Strathbogie	Stable	Stable	Stable	**Stable**	-
Upper Goulburn	Declining	Stable	Declining	**Stable**	-
Loddon groundwater catchment					
Mid Loddon	Declining	Stable	Declining	**Declining**	Declining
Ovens groundwater catchment					
Barnawartha	Stable	Rising	Rising	**Stable**	-
Lower Ovens	Declining	Stable	Stable	**Declining**	Declining
Upper Murray groundwater catchment					
Kiewa	-	-	Stable	**Stable**	-
Upper Murray	-	-	Stable	**Stable**	-
Otway-Torquay groundwater region					
Hopkins-Corangamite groundwater catchment					
Bungaree (2)	Stable	Stable	Stable	**Stable**	Declining
Cardigan	Declining	Stable	Stable	**Declining**	Declining
Colongulac	Stable	Stable	Rising	**Rising**	-
Gellibrand	Stable	Stable	Stable	**Stable**	Declining
Gerangamete	Declining	Stable	Stable	**Declining**	Declining
Newlingrook	Stable	Stable	Stable	**Stable**	Declining
Paaratte	Stable	Stable	Stable	**Stable**	Rising
South West Limestone (5)	-	-	Stable	**Stable**	-
Otway-Torquay groundwater catchment					
Jan Juc	Declining	Stable	Stable	**Stable**	Declining
Portland groundwater catchment					
Portland	Declining	Declining	Declining	**Declining**	-
Wimmera-Mallee groundwater region					
West Wimmera groundwater catchment					
West Wimmera	Stable	Stable	Stable	**Stable**	Stable
West Wimmera – Neuarpur subzone1 (6)	Declining	Declining	Declining	**Declining**	Declining

Notes

(1) The following groundwater management areas 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.

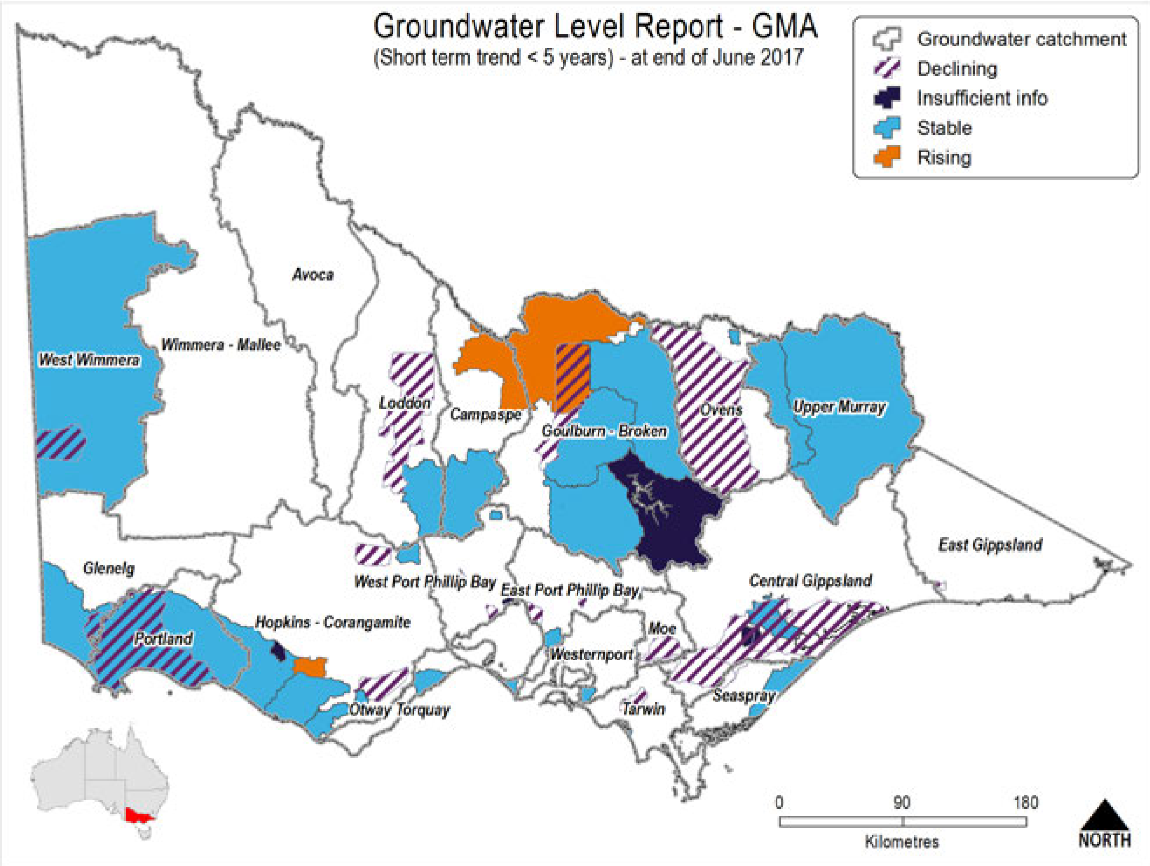
(3) Rosedale and Stratford include the dewatering activities from the Loy Yang and Morwell coal mines.

(4) The Central Victorian Mineral Springs GMA is partly contained within the Campaspe and Loddon groundwater catchments.

(5) The South West Limestone GMA is partly contained within the Hopkins–Corangamite, Portland and Glenelg groundwater catchments.

(6) Restrictions on seasonal allocations are in place to address the trend deviation in the Neuarpur subzone in the West Wimmera GMA.

Figure 2-12 Groundwater trends in groundwater management areas

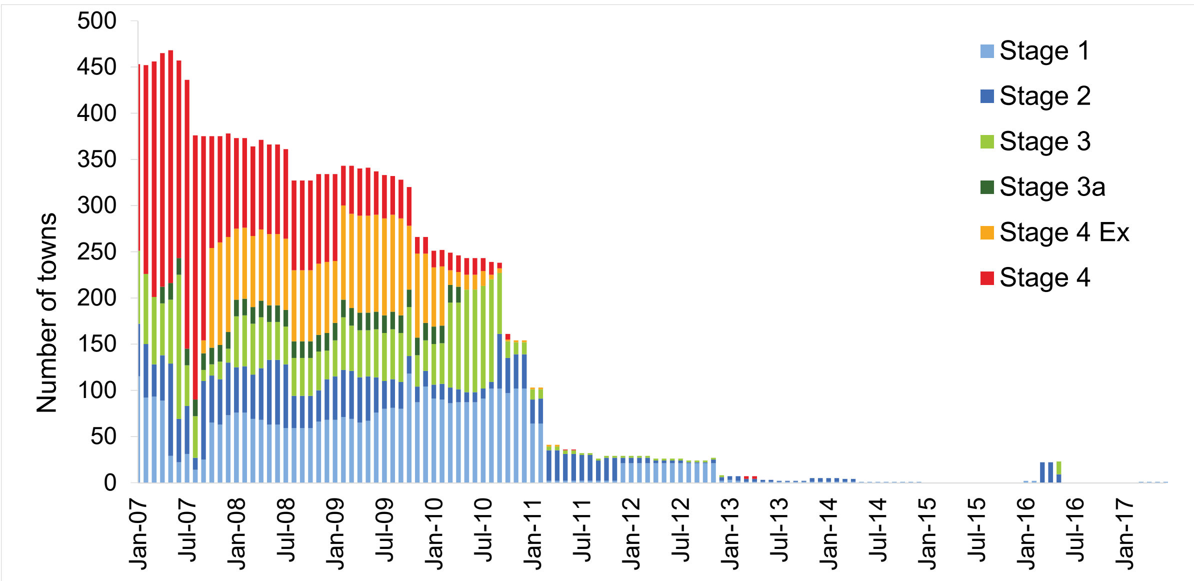


2.5 Response to water availability

2.5.1 Urban water restrictions

Urban water restrictions were only applied to one town in 2016–17, compared to 35 in 2015–16. Stage 1 restrictions were applied to Korumburra by South Gippsland Water in March and remained in place until 30 June 2017. 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 2016–17 (Table 2-4).

Figure 2-13 Number of towns and severity of water restrictions, Victoria, February 2007 to June 2017



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 2016–17

Water corporation	Water system and towns	Level of water restrictions in 2016–17
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 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 allocations in regulated systems

With below-average rainfall and inflows received in the previous two years, reserves available for 2016–17 were minimal, and planning was occurring to identify actions if 2016–17 continued to provide dry conditions. In 2015–16, the resource manager in northern Victoria predicted that if conditions remained dry, opening allocations would be very low: this was reflected in the initial allocations announced in July and August 2016 for almost all systems. However, following significant rainfall in spring 2016, this changed and season allocation increased. By February 2017, all systems in Victoria received seasonal determinations of 100% high-reliability water shares (Table 2-5).

In Victoria's declared systems, both in the north and south, all high-reliability entitlements reached 100% allocation in 2016–17, compared to 2015–16 when only the Murray and Thomson-Macalister systems reached 100% allocation for high-reliability entitlements.

In northern Victoria, the Bullarook, Campaspe and Broken systems reached 100% allocation for low-reliability entitlement. For the first time since their creation, low-reliability water shares in the Murray system reached 5% in February 2017.

In southern Victoria, the Thomson–Macalister irrigation system received a 20% allocation against low-reliability entitlement. The Werribee and Bacchus Marsh system received a 75% allocation for low-reliability entitlement.

Allocations for the Wimmera Mallee Pipeline Product began with initial allocations of 0% which then reached and remained at 100% after February 2017. 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	2016–17			2015–16
		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	1	100	**100**	**100**
	Low-reliability	0	0	**5**	**0**
Goulburn	High-reliability	8	100	**100**	**90**
	Low-reliability	0	0	**0**	**0**
Broken	High-reliability	0	100	**100**	**26**
	Low-reliability	0	100	**100**	**0**
Campaspe	High-reliability	0	100	**100**	**66**
	Low-reliability	0	100	**100**	**0**

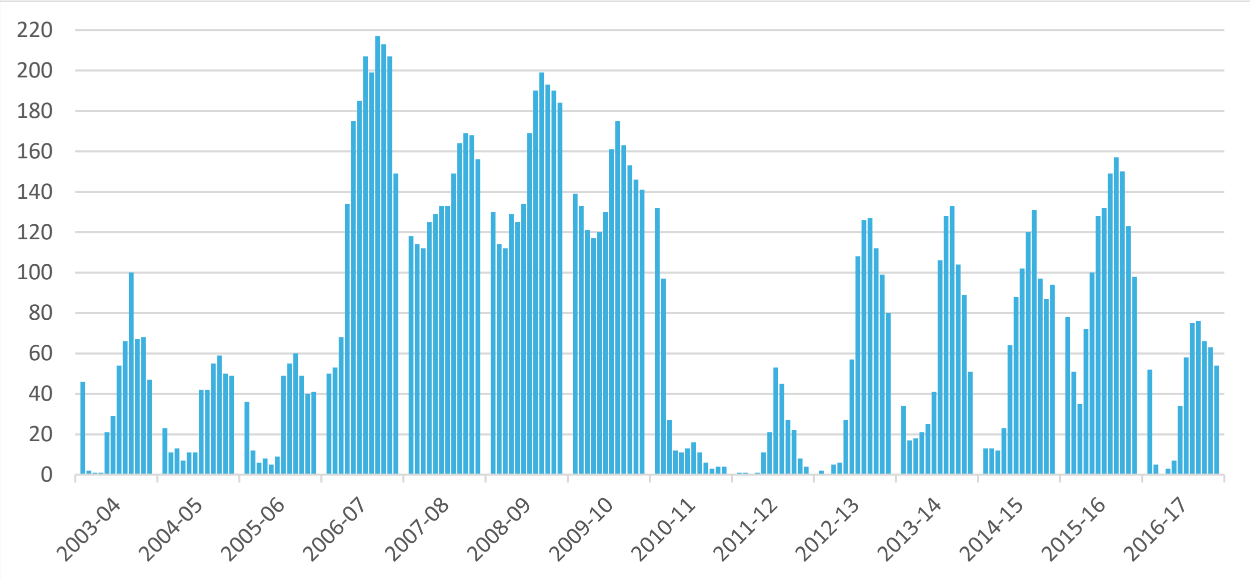
Loddon	High-reliability	0	100	**100**	**84**
	Low-reliability	0	0	**0**	**0**
Bullarook	High-reliability	0	100	**100**	**8**
	Low-reliability	0	100	**100**	**0**
Southern declared systems					
Thomson–Macalister	High-reliability	70	100	**100**	**100**
	Low-reliability	0	0	**20**	**20**
Werribee and Bacchus Marsh	High-reliability	0	100	**100**	**15**
	Low-reliability	0	55	**75**	**0**
Non-declared systems					
Wimmera-Mallee	Pipeline product	0	100	**100**	**16**
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) GMW (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 76 in March 2017, compared to 157 in the previous year (Figure 2-14). Victoria experienced the tenth-wettest spring on record and the wettest spring since 2010, and this was reflected in the low number of restrictions. September 2016 was the first time since August 2012 that there have been no restrictions on diversions from unregulated streams. This year was also the first time since 2011–12 when there have been less than 100 streams on restrictions each month. There were 63 streams subject to restrictions in May 2017, compared to 123 at the same time in the previous season. There were 54 streams on restrictions at the end of 2016–17.

Figure 2-14 Number of Victorian unregulated streams on restrictions, June 2003 – June 2017



2.5.4 Groundwater restrictions

Groundwater restrictions in 2016–17 were similar to the previous year, when entitlement holders in the same four groundwater management units 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's seasonal allocation of 70% in all zones also remained in place from 2015–16.

In the Loddon groundwater catchment, the allocation limits varied across the Loddon Highlands WSPA zones for entitlement holders:

- the Newlyn zone began the year with a 50% seasonal allocation, which was raised to 75% in October 2016
- the 75% allocation limit on the Ascot and Blampied zones was lifted in November 2016, with entitlement holders able to access 100% of the allocation limit through to the end of the water year

- all other zones had a 100% allocation limit.

In the West Port Phillip Bay groundwater catchment, Deutgam WSPA received a seasonal allocation of 25% during 2016–17 on 1 July 16. On 24 November 2016, this was increased to 50% when Southern Rural Water adopted new groundwater allocation rules for Deutgam WSPA, to protect the Deutgam Aquifer and provide groundwater security.

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. Compared to the four instances in the previous year, in 2016–17 water carting was not used to supplement supplies.

2.5.6 Temporary qualification of rights to water

In 2016–17, the Minister for Water did not qualify any rights to water.

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 2016–17 and 2015–16. 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, 2016–17 and 2015–16

Entitlement type	Volume 2016–17 (ML)	Volume 2015–16 (ML)
Surface water		
Bulk entitlements (1)	5,412,100	5,578,347
Licences (2)	274,287	275,756
Small catchment dams (3)	434,974	434,974
Total surface water entitlements	**6,121,362**	**6,289,077**
Groundwater		
Licences	961,575	958,647
Bulk entitlements	10,000	10,000
Total groundwater entitlements	**971,575**	**968,647**
Total entitlements	**7,092,937**	**7,257,724**

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 Victorian Environmental Water Holder 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 2016–17 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 2016–17 was 32,239,118 ML, more than twice the amount available in the previous year. Of this, 3,633,465 ML was taken for consumptive purposes, lower than the 4,398,170 ML taken in 2015–16.

The volume of surface water taken in 2016–17 was 52% of the total entitlement volume.

Table 3-2 Victoria's water availability and water taken for consumptive use, 2016–17

Water source	Available resource (ML)	Total entitlements (ML)	Total taken (ML)
Surface water (1)	30,907,414	6,121,362	3,197,982
Groundwater (2)	838,103	971,575	351,672
Recycled water (3)	493,601	n/a	83,811
Total 2016–17	**32,239,118**	**7,092,937**	**3,633,465**
Total 2015–16	14,255,141	7,257,724	4,398,170

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 allocation limit of each GMU.

(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 2016–17. Part 2 has more information about diversions under surface water entitlements in each basin.

The difference in bulk entitlement volumes from 2015–16 to 2016–17 is attributed to changes explained below. The entitlements and their volumes are in detailed in Chapter 6 for each basin. Environmental entitlements are outlined separately in Chapter 4, as they are not considered to be consumptive use entitlements.

The volume of water taken under bulk entitlements in 2016–17 was 50% of the total volume of bulk entitlements, and the volume of water taken under take and use licences was 26% of the total volume of licences.

Table 3-3 Volume of surface water entitlements and volume and percentage taken for consumptive use, 2016–17

Basin	Bulk entitlements (1)			Licences (2)			Small catchment dams (3)
	Entitlement volume (ML)	Volume taken (ML)	Proportion of entitlement taken (%)	Entitlement volume (ML)	Volume taken (ML)	Proportion of entitlement taken (%)	Volume taken (ML)
Murray	1,867,097	1,088,092	58%	16,248	3,483	21%	12,000
Kiewa	1,106	489	44%	15,510	4,071	26%	7,440
Ovens	50,422	11,433	23%	17,022	3,741	22%	23,754
Broken	25,279	9,232	37%	2,718	514	19%	16,766
Goulburn	1,892,925	705,173	37%	23,965	12,790	53%	47,106
Campaspe	105,648	31,688	30%	3,134	690	22%	22,032
Loddon	138,684	37,647	27%	22,186	5,775	26%	39,361
East Gippsland	622	124	20%	659	95	14%	711
Snowy	2,201	680	31%	3,958	473	12%	2,811
Tambo	342	24	7%	4,119	245	6%	3,661
Mitchell	9,208	4,537	49%	16,385	9,974	61%	4,517
Thomson	414,587	287,045	69%	17,237	4,611	27%	5,475
Latrobe	221,692	80,084	36%	18,905	5,766	30%	22,802
South Gippsland (4)	18,887	7,906	42%	12,813	2,443	19%	28,387
Bunyip	36,595	20,130	55%	18,896	4,875	26%	32,837
Yarra	400,000	302,147	76%	42,773	6,200	14%	17,346
Maribyrnong	10,711	2,788	26%	2,054	321	16%	6,876
Werribee	37,617	15,380	41%	1,019	8	1%	5,484
Moorabool	40,600	15,090	37%	3,567	1,000	28%	13,012
Barwon	55,733	43,314	78%	5,510	1,213	22%	20,793
Corangamite	0	0	0%	1,117	108	10%	8,365
Otway Coast	19,667	12,584	64%	6,043	766	13%	15,556
Hopkins	629	164	26%	11,407	2,018	18%	21,446
Portland Coast	0	0	0%	1,078	0	0%	3,847
Glenelg	4,554	1,776	39%	1,044	50	5%	18,899
Millicent Coast	0	0	0%	4	4	98%	5,609
Wimmera	57,016	14,038	25%	2,228	166	7%	18,310
Mallee	0	0	0%	0	0	0%	8
Avoca	278	31	11%	2,689	40	1%	9,765

Total 2016–17	**5,412,100**	**2,691,596**	**50%**	**274,287**	**71,438**	**26%**	**434,974**
Total 2015–16	5,578,347	3,339,077	60%	275,756	71,144	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 Victorian Environmental Water Holder 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) In previous years, the bulk entitlement volume for the South Gippsland basin includes 150,000 ML of entitlement from the desalination plant. This amount is now reported separately outside of the main entitlement table in the Yarra basin section.

During 2016–17, some bulk entitlements were amended to change the volume of water available or to change the operating rules. Amendments to the three Melbourne retailers Greater Yarra System – Thomson River Pool bulk entitlements were required to enable 3.9% of inflows from Thomson Reservoir (8 GL/year long-term average) to be transferred to the Victorian Environmental Water Holder. This was implemented by reducing the volume of the Melbourne retailers Greater Yarra System – Thomson River Pool bulk entitlements by the equivalent volume. 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.

The large difference in total bulk entitlement volume between 2015–16 and 2016–17, 166,247 ML less entitlement in this year, is largely explained by the movement of the 150,000 ML of entitlement for the desalination plant being moved out of this table. It is now reported separately in the Yarra basin.

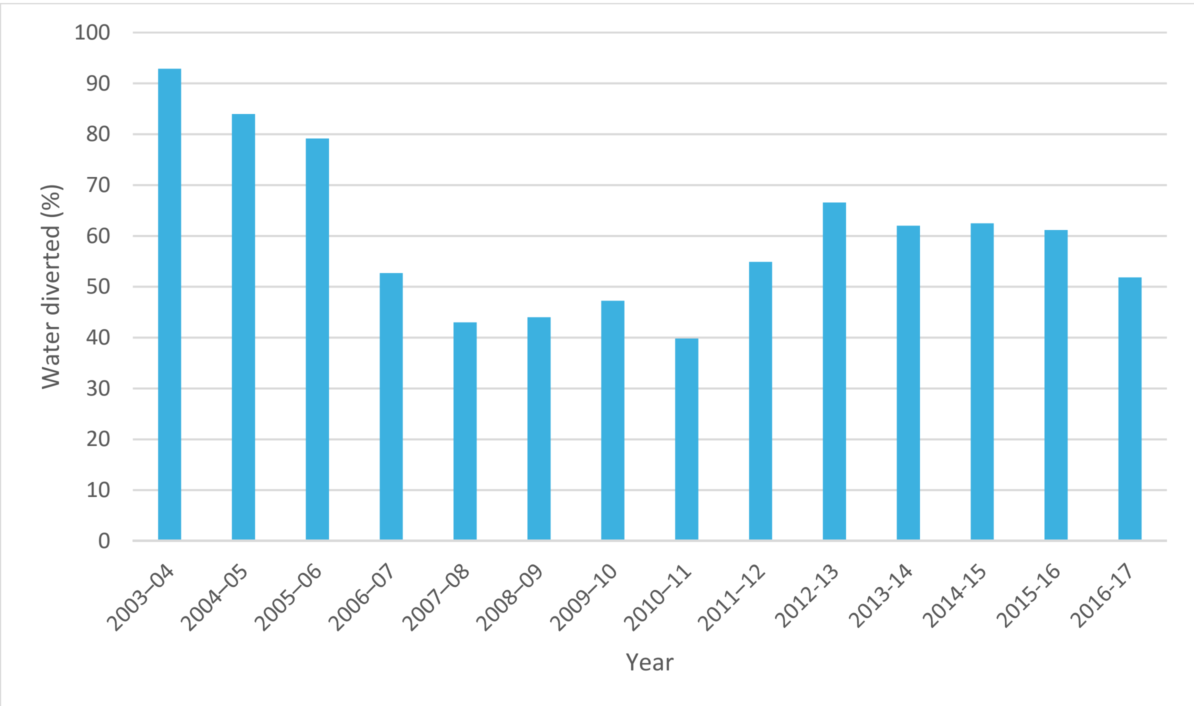
Figure 3-1 shows the volume of water taken under surface water entitlements in the past 10 years.

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. In 2016–17 lower water use was again observed, reflecting the wet 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).

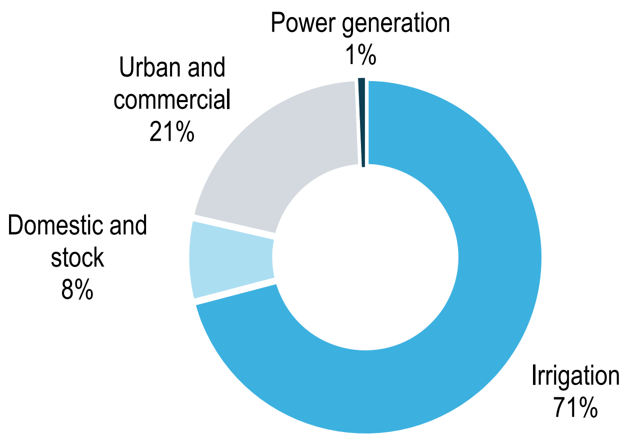
As shown in Table 3-4, the volume of water taken for consumptive use under surface water entitlements in 2016–17 was less than in 2015–16.

Irrigation is the largest consumptive use of surface water in the state, comprising 71% of all water taken in 2016–17, as shown in Figure 3-2.

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

Consumptive end use	2016–17		2015–16	
	Volume diverted (ML)	Proportion of total consumptive diversions (%)	Volume diverted (ML)	Proportion of total consumptive diversions (%)
Irrigation	2,267,925	71%	2,858,727	74%
Domestic and stock	245,238	8%	245,238	6%
Urban and commercial	663,545	21%	715,074	19%
Power generation	21,274	1%	26,157	1%
Total	**3,197,982**	**100%**	**3,845,196**	**100%**

Figure 3-2 Percentage of water taken for different consumptive uses under surface water entitlements, Victoria, 2016–17



3.2 Groundwater entitlements and use

In 2016–17, some groundwater management units (GMUs) had their status approved. The Wandin Yallock and Bungaree WSPA had their status revoked in December 2016, and local management plans for the Broken and Eildon GMAs were approved in October and September 2016 respectively.

Full details of water entitlements and use from each GMA and WSPA in 2016–17 are in Appendix C.

In 2016–17, total groundwater licensed entitlement was 971,575 ML across the state. The total groundwater use across the state including domestic and stock use was about 351,672 ML, which was less than the volume used in 2015–16 (457,374 ML).

There are 28,588 stock and domestic bores in Victoria. Domestic and stock use (47,465 ML) was estimated to account for about 13% of total groundwater use.

In Victoria's GMAs, licensed groundwater entitlements totalled 621,774 ML with total use of 191,694 ML. Licensed groundwater entitlements in WSPAs totalled 251,741 ML with total use of 96,819 ML of metered extractions. The volume of groundwater entitlements outside groundwater management units (previously known as unincorporated areas) was 98,060 ML, with 15,699 ML extracted.

The total volume of groundwater extracted for urban use in 2016–17 was 9,824 ML, which was about 3% of the total groundwater extracted.

A total of 72 cities and towns have a groundwater entitlement for primary or supplementary water supply. In 2016–17, 56 of these cities and towns recorded some level of groundwater extraction. The largest urban users were Portland, Sale and Geelong, each with extraction of between 1,500 ML and 1,900 ML.

Figure 3-3 shows the location of towns where groundwater is used for urban water supply.

Figure 3-3 Location of towns where groundwater is extracted for urban supply

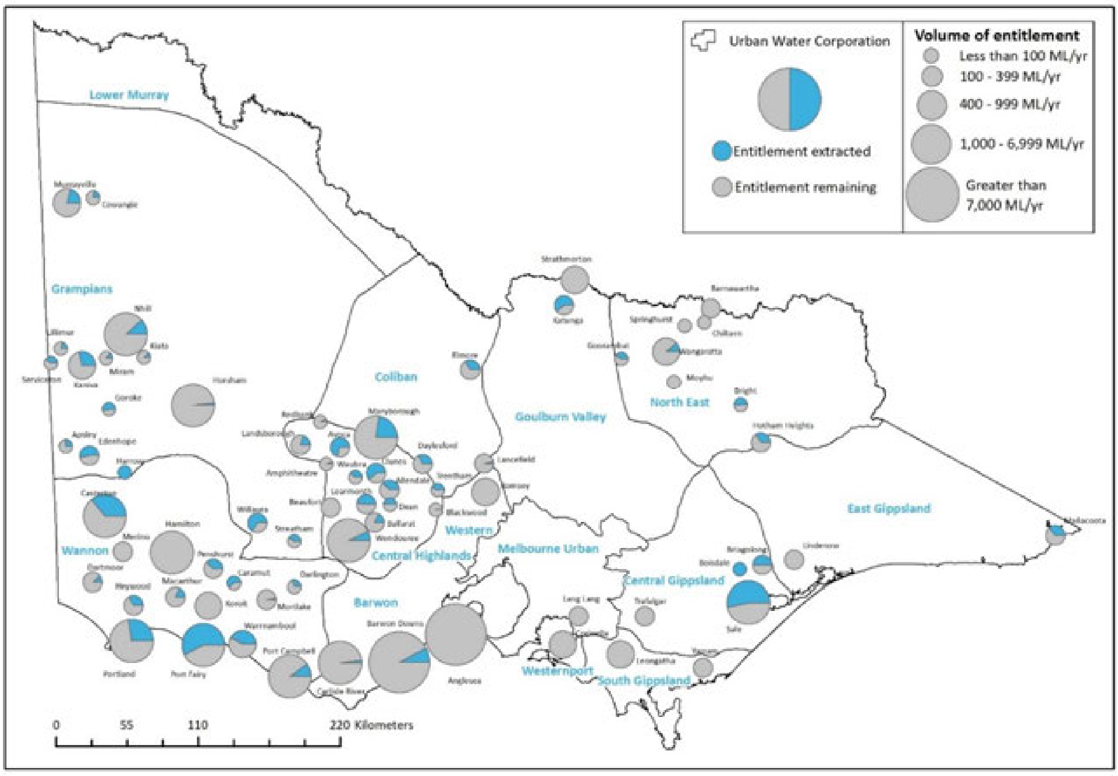
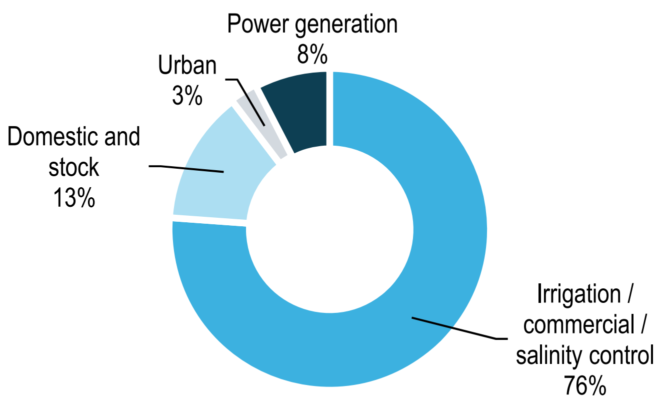


Table 3-5 and Figure 3-4 show the groundwater extraction by type of use in 2016–17.

Table 3-5 Groundwater extraction by type of end use, 2016–17

Consumptive end use	2016–17		2015–16	
	Volume diverted (ML)	Proportion of total consumptive diversions (%)	Volume diverted (ML)	Proportion of total consumptive diversions (%)
Irrigation / commercial / salinity control	267,716	76%	370,896	81%
Domestic and stock	47,465	13%	48,349	11%
Urban	9,824	3%	11,125	2%
Power generation	26,667	8%	27,004	6%
Total	**351,672**	**100%**	**457,374**	**100%**

Figure 3-4 Groundwater extraction by type of end use, 2016–17



3.3 Recycled water production

The total volume of 493,601 ML of wastewater produced in 2016–17 was higher than the 450,062 ML produced in 2015–16 (Table 3-6). The volume of water recycled by Victoria's water corporations decreased from the previous year, and use external to treatment plants (within process volumes) was slightly lower than in 2015–16. In 2016–17 use external to treatment plans was65,293 ML, which was less than the 76,615 ML recycled for external uses in 2015–16. An additional 18,517 ML was recycled for use in wastewater treatment process. The volumes and percentages only refer to recycled water supplied for use external to the wastewater treatment plants and does not include the water recycled within the plant process.

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 33,829 ML or 9%. 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 24% (or 31,465 ML) of the wastewater available for reuse.

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 2016–17, the volume of water recycled by the Eastern Treatment Plant was 15,257 ML, which was a decrease on the 17,132 ML recycled in 2015–16.

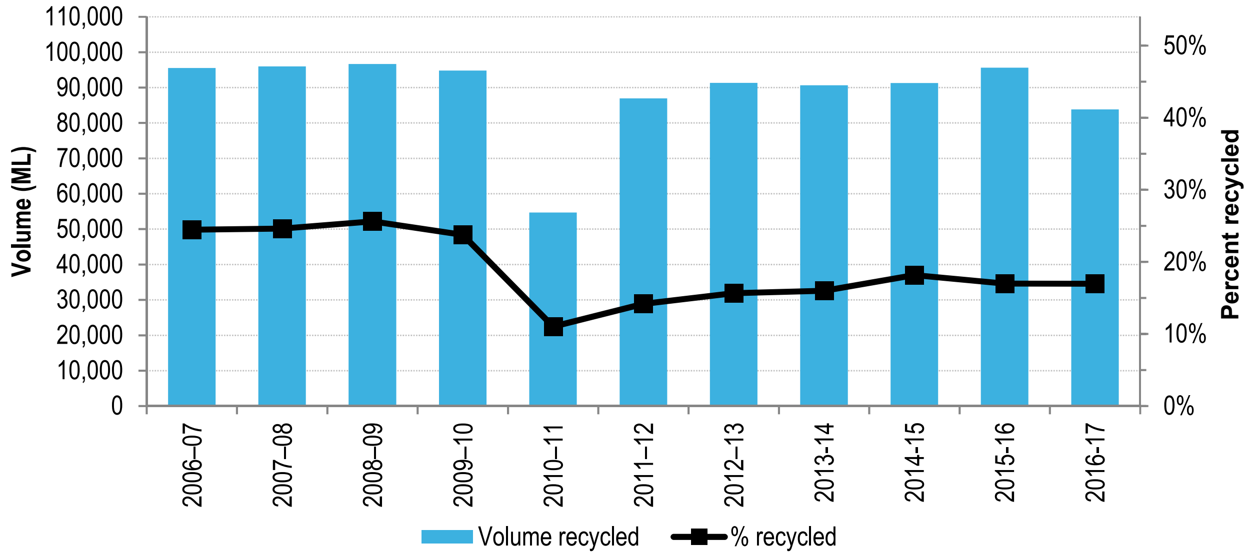
The volume of water recycled by the Western Treatment Plant decreased from 25,753 ML in 2015–16 to 23,589 ML in 2016–17.

Table 3-6 Volume of wastewater recycled, 2016–17

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	297	80	27%	35	44	0	0	94	124
Barwon	33,882	3,199	9%	935	1,262	147	855	11,072	19,610
Broken	445	445	100%	0	445	0	0	0	0
Bunyip	158,433	18,174	11%	6,419	519	0	11,236	93	140,167
Campaspe	2,359	1,235	52%	195	1,039	0	1	1124	0
Corangamite	2,426	471	19%	12	459	0	0	1,955	0
East Gippsland	130	130	100%	0	130	0	0	0	0
Glenelg	1236	632	51%	76	556	0	0	604	0
Goulburn	7,306	5,163	71%	436	4,726	0	0	2143	0
Hopkins	6,940	793	11%	144	567	0	82	478	5,669
Kiewa	406	146	36%	5	141	0	0	260	0
Latrobe	23,489	773	3%	111	46	616	0	3,410	19,306
Loddon	9,134	1,673	18%	813	860	0	0	6,405	1056
Mallee	0	0	0%	0	0	0	0	0	0
Maribyrnong	7,046	4,413	63%	390	576	0	3,447	2,633	0
Millicent Coast	105	38	36%	38	0	0	0	0	68
Mitchell	1,709	1,568	92%	0	305	1,263	0	141	0
Moorabool	1,287	1,271	99%	1,198	14	0	59	0	16
Murray	11,050	4,079	37%	136	3,842	0	101	4,248	2,723
Otway Coast	1,589	256	16%	0	210	0	47	209	1123
Ovens	3,291	1,010	31%	72	938	0	0	2,281	0
Portland Coast	2,882	63	2%	0	63	0	0	277	2,543
Snowy	237	237	100%	0	237	0	0	0	0
South Gippsland	5,351	443	8%	71	360	0	12	1,229	3,679
Tambo	883	883	100%	0	883	0	0	0	0
Thomson	1,313	1,285	98%	3	1,282	0	0	28	0
Werribee	194,749	30,114	15%	8,142	15,904	5,602	466	3452	161,183
Wimmera	2,639	1,686	64%	384	1302	0	0	335	618
Yarra	12,987	3,551	27%	296	1044	0	2,211	8,444	991
Total 2016–17	**493,601**	**83,811**	**17%**	**19,911**	**37,754**	**7,628**	**18,517**	**50,915**	**358,876**
Total 2015–16	450,062	95,600	17%	26,363	44,178	6,074	18,985	36,880	317,583

Figure 3-5 shows the trend in recycled water over the 10 years to 2016–17.

Figure 3-5 Recycled water volume and percentage, 2006–07 to 2016–17 (1)



Note

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

3.4 Desalination water production

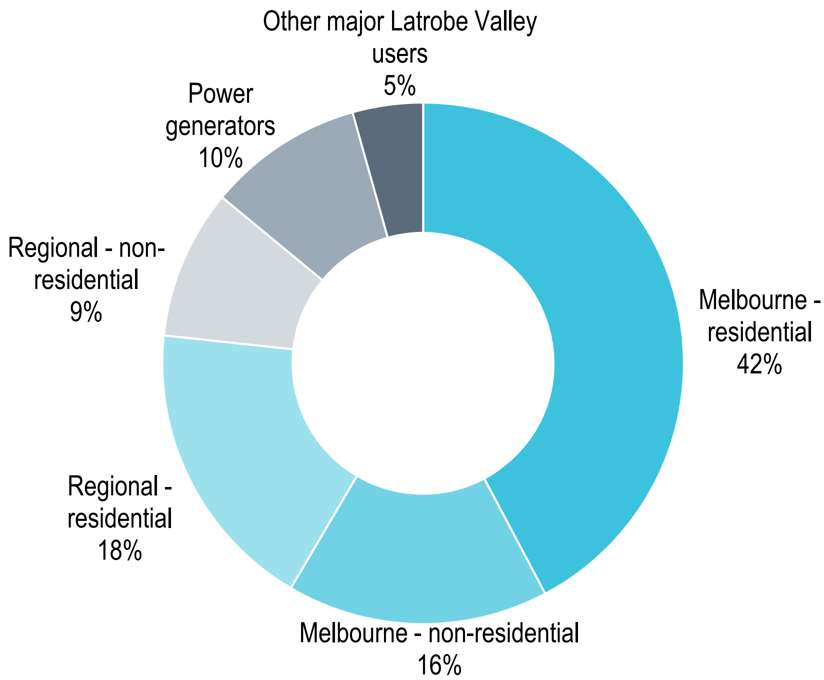
The water produced by the Victorian Desalination Project is transferred into Cardinia Reservoir and combines with the water available for consumptive use. See Chapter 1.1.4 for more information about the project.

The project began delivering water on 19 March 2017. For the 2016–17 supply period, 46,143 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, 2016–17



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 targeted so that the right amount of water is 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.

Three main organisations hold water entitlements for the environment in Victoria: the Victorian Environmental Water Holder (VEWH), the Commonwealth Environmental Water Holder (CEWH) and the Murray–Darling Basin Authority (MDBA).

VEWH

The VEWH is an independent body 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, MDBA and environmental water managers in New South Wales and South Australia — to optimise the benefits of all delivery of water for the environment in and from northern Victorian waterways. In most cases, when water held by the CEWH or MDBA is to be delivered in Victoria, the CEWH and MDBA transfer the agreed amount of water to the VEWH. That water is held by the VEWH until used or transferred back.

Further information about the VEWH's planning processes for use of the environmental water holdings, the program achievements and outcomes of environmental watering in 2016–17 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 entitlements that were acquired through the Australian Government's investment in water-saving infrastructure and purchases. The CEWH receives annual allocations against its water entitlements and partners with the VEWH and Victorian waterway managers to deliver this water for the environment in Victoria.

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

Environmental water holders also 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 their carryover water and water trades to achieve the best environmental outcomes.

4.1 Managed environmental water

4.1.1 Annual overview

CEWH

A net total of 351,107 ML of Commonwealth 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, Goulburn, Loddon and Broken systems, Hattah Lakes and Gunbower Creek. A total of 40,000 ML of Commonwealth allocation held in VEWH accounts was transferred to South Australia to meet downstream environmental demands. Following the completion of environmental watering, 4,938 ML of unused Commonwealth environmental water was returned to the CEWH. During 2016–17, the CEWH had its first allocation to its Wimmera and Glenelg rivers supply by agreement since purchasing the entitlement in 2012. The allocation was received late in the season and carried over for use in 2017–18.

MDBA – Living Murray allocation

A net total of 5,890 ML of Living Murray allocation was transferred to accounts held by the VEWH to contribute to priority watering actions in the Goulburn River and at Living Murray icon sites, including the Barmah Forest and Wallpolla Island. This total includes 10,000 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 sixth year managing water for the environment in Victoria. In 2016–17, 98% of identified potential watering actions were fully or partially achieved through a combination of naturally wet conditions and managed environmental flows (Table 4-1). This is the highest proportion of actions the VEWH has achieved since it started. The change to wetter conditions in most of the state meant that only a limited amount of carryover was required to deliver critical water releases in the winter-spring period. Water that had been planned for release for the environment over spring and summer was not delivered to reduce flood risk or was no longer needed in the 2016–17 year, as sites were watered naturally. At the same time, some areas of Gippsland had their lowest total summer rainfall on record, and water was released to support the plants and animals in this dry time.

The *Bulk Entitlement (Thomson River – Environment) Order 2005* was amended to provide an additional 8 GL a year on average, to fulfil water recovery commitments made by the State Government. The water became available in late 2016–17.

The VEWH coordinated delivery of environmental water to 76 priority river reaches and 51 wetlands – a total of 127 sites across Victoria. Fewer wetlands and reaches were actively watered in 2016–17 compared to the previous three years, because the objectives for many waterways were met by natural flows.

Table 4-1 Watering actions achieved

	2016–17	2015–16
Managed environmental watering sites		
Number of river reaches delivered to	76	73
Number of wetlands delivered to	51	73
Number of priority watering actions achieved	250	171
Percentage of priority watering actions achieved	98%	76%
Number of priority watering actions achieved using managed environmental water	136	135

The volume of total managed environmental water available in 2016–17 was 1,717,617 ML, which was less than the year before. Of this total available, 706,468 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 2016–17.

Table 4-2 Summary of managed environmental watering, 2016–17 (ML)

Managed environmental water	2016–17	2015–16
Availability		
Carryover	561,839	348,549
Seasonal allocations	1,160,364	867,972
Return flows (1)	229,776	591,199
Less carryover lost to spill	234,362	n/a
Total available (2)	**1,717,617**	**1,805,751**
Volumes delivered in Victoria		
Volume delivered to off-stream wetlands	69,772	73,181
Volume delivered in-stream	636,696	616,350
Total volume delivered	**706,468**	**689,532**

Notes
(1) 'Return flows' means the volume of water released in-stream by the VEWH and made available for further re-use by the environment at a downstream location.
(2) 'Total available' does not include any water traded to the environmental water holders from other users.
n/a Not applicable.

Return flows

In some systems, water for the environment delivered through upstream sites can be used again downstream. This helps to ensure it is used efficiently and effectively to achieve optimal environmental benefits. The VEWH's access to return flows is enabled through rules in its bulk and environmental entitlements. Reuse of return flows is also available to the CEWH and MDBA when the VEWH delivers water under its bulk and environmental entitlements on their behalf.

In 2016–17, a total of 229,776 ML was recredited to the VEWH accounts for return flows delivered through upstream sites to the Murray River.

Environmental water holders use trade to manage their water portfolios effectively. Trades include administrative transfers (moving water between environmental water holder accounts) and commercial trades (selling and purchasing allocation on the market). In 2016–17, allocation trades undertaken by environmental water holders included:

- selling water allocation commercially
- transferring all allocations made to the Snowy Water Initiative entitlements to the Snowy Scheme in accordance with conditions of those entitlements (see section 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 2016–17.

Table 4-3 Summary of key trade activities undertaken by environmental water holders, 2016–17 (ML)

Managed environmental water - other actions	2016–17	2015–16
Net volume sold to non-environmental users (ML)	20,000	22,336
Volume transferred to the Snowy Scheme (ML) (1)	85,910	75,807
Volume delivered via the Murray River to South Australia (ML)	305,827	688,478
Total other actions (ML)	**411,737**	**786,621**

Note
(1) 'The volume of allocation transferred from the Victorian Murray, Goulburn and Loddon systems to the Snowy Hydro-electric 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 2017 and the volumes made available and used during 2016–17. A total of 1,717,617 ML was made available under these entitlements during the year (before trade), of which 706,468 ML was used for environmental benefit within Victoria.

The table includes entitlements held in Victorian river basins for environmental purposes by the VEWH, 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 not linked to a water storage, and access to water is only permitted on an opportunistic basis: that is, when water is actually flowing in a river, rather than being captured 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 is needed to supply consumptive uses
- 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, 2016–17 (ML)

	Basin	Entitlement type/ reliability	Entitlement volume at 30 June 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 2016 (h) = (e)+(f)-(g)
Northern	Murray [3]	High	444,792	374,892	211,959	602,161	229,297	994,391	301,057	386,069	307,265
		Low	137,656								
		Provisional	75,000								
		Unregulated	74,300								
	Ovens	High	123	0	0	70	0	70	0	70	0
	Broken	High	253	65	0	192	0	257	0	0	257
		Low	4								
	Goulburn	High	405,445	108,056	0	389,987	0	498,043	-127,425	240,283	130,335
		Low	215,563								
	Campaspe	High	27,372	14,580	14,580	36,697	0	36,697	-17,137	5,551	14,009
		Low	8,409								
	Loddon	High	7,306	9,886	7,243	14,777	0	17,420	-2,148	12,432	2,840
		Low	2,551								
		Provisional	7,590								
		Total Northern systems		**507,478**	**233,781**	**1,043,884**	**229,297**	**1,546,878**	**447,767**	**644,405**	**454,706**
Western	Wimmera & Glenelg	High	40,560	7,022	0	55,840	0	62,862	5,000	13,585	54,277
		Provisional	1,024								
		CEWH	28,000								
		Total Western systems		**7,022**	**0**	**55,840**	**0**	**62,862**	**5,000**	**13,585**	**54,277**
Central	Tarago [4]	Share of inflows	10.3%	1,648	0	1,954	0	3,602	0	1,952	1,650
	Yarra	High	17,000	24,278	0	17,000	0	41,278	0	21,544	19,734
	Werribee [4]	Share of inflows	10%	1,399	32	1,357	479	3,203	896	2,076	2,024
	Maribyrnong [5]	n/a	n/a	0	0	0	0	0	304	304	0
	Moorabool [4]	Share of inflows	11.9%	730	0	6,162	0	6,892	0	1,965	4,927
	Barwon	Unregulated	n/a	n/a	0	n/a	n/a	n/a	n/a	n/a	n/a
		Total Central systems		**28,056**	**32**	**26,472**	**479**	**54,975**	**1,201**	**27,841**	**28,335**
Gippsland	Latrobe	Unregulated	n/a	15,780	0	2,811	0	18,591	744	3,713	15,622
		Share of inflows	9%								
	Thomson	High + Share of inflows	22,461	3,504	549	31,357	0	34,312	1	16,925	17,388
		Passing flows	6,230								
		Total Gippsland systems		**19,284**	**549**	**34,168**	**0**	**52,903**	**745**	**20,637**	**33,010**
Total				**561,839**	**234,362**	**1,160,364**	**229,776**	**1,717,617**	**440,821**	**706,468**	**570,328**

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 was able to be used during the 2016–17 year. Last year it wasn't available for use, so was not included.

(4) Seasonal allocation in the Tarago, Werribee and Moorabool systems includes adjustments made during the year for corrections and alterations to account for water lost and gained from internal spills, evaporation, over-releases and changes in storage volume.

(5) There are no entitlements held for the environment in the Maribyrnong system, but the VEWH purchased 304 ML of allocation from other entitlement holders.

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 Hydro-electric 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 by recovering water from the Murray, Goulburn and Loddon systems by 2012. This resulted in the creation of 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. These transfers effectively reduce the amount of water required to be delivered from the Snowy Scheme to the Murray River. This then offsets the volume of water that must be supplied from the Snowy system to the Murray and Murrumbidgee rivers, thereby freeing up water for environmental flows in the Snowy while ensuring the equivalent amount of consumptive water is still available in the Murray River.

In 2016–17, the VEWH transferred a total of 85,911 ML to the Snowy Scheme. This is more than the volumes made available in 2015–16 (75,807 ML) due to higher seasonal allocations in the Murray, Goulburn and Loddon rivers at 31 January 2017, compared to 31 January 2016. Including contributions from New South Wales, a total of 284,334 ML was transferred to the Snowy Scheme in 2016–17 (Table 4-5). Of this volume, 214,334 ML was assigned for release to the Snowy River and 70,000 ML to the Murray River.

Table 4-5 Water available under Snowy Water Initiative 2016–17 (ML) (1)

Entitlement source	Entitlement volume (ML)	Volume made available for release in 2016–17 (ML)
Victoria (2)	115,939	85,911
New South Wales (3)	192,219	198,424
Total	**308,158**	**284,334**
Volume apportioned to Snowy River Increased Flows (4)		*214,334*
Volume apportioned to Murray River Increased Flows		*70,000*

Notes

(1) The information about the Snowy River entitlements was sourced from the New South Wales Office of Water.

(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 exceeded the 21% annual natural flow target by 2,334 ML. This was the first time the Snowy River allocation had reached the target volume. However, ambiguities in the Snowy Water Licence and Snowy Water Inquiry Outcomes Implementation Deed around whether or not compensation is payable to Snowy Hydro Limited to deliver more than 212,000 ML in any one year resulted in the additional water being withheld from planned deliveries in 2017–18.

2016–17 was the first time a large volume of River Murray Increased Flows (50,000 ML in Victoria and 50,000 ML in NSW) was delivered to support environmental watering in the Murray River. This allowed environmental water managers to meet priority demands across the southern connected basin and trial the delivery of targeted flows in autumn–winter, to increase native fish habitat in the Murray River.

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 the holders must report on their compliance with these requirements.

No major breach of passing flows compliance was reported in 2016–17. However, three minor failures to meet passing flows requirements occurred, as reported below.

Goulburn-Murray Water was unable to meet passing flow requirements once in 2016–17. Due to maintenance works at Lake Eppalock, the flow was less than the required flow for four days in June downstream of Lake Eppalock. Minimum passing flows not provided were credited to the passing flow account for later use. There were five days of minimum-flow non-compliance during the year, due to fluctuations in calculated inflows.

Western Water was unable to meet the minimum passing flows requirements twice:

- 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 2016–17. This was compensated by ensuring average passing flows over the year exceeded the shortfall. To improve the manual process, telemetry was added in 2016–17 with alarming due to be completed in 2017–18 to further improve compliance with passing flow requirements
- passing flow requirements on Main Creek require manual operation. On six occasions, an overextraction occurred, resulting in passing flow requirements not being met. This was compensated by ensuring average

passing flows over the year exceeded the shortfall. Telemetry and alarming has been added to this monitoring network, to 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 to capture and formalise existing rules in 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 2016–17. A peak of 76 were on restrictions in March 2017, much lower than the 157 in the previous year. See Chapter 2.5.3 for more information.

In 2016–17, 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 has commenced	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	A process to amend the Olinda Creek streamflow management plan is underway.	

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 2016–17, there were four groundwater management units subject to restrictions, the same as in 2015–16. See Chapter 2.5.4 for more information.

In 2016–17, 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 proposed *Katunga WSPA Groundwater Management Plan* was submitted to the Minister for Water for approval in 2017-18.

Wandin Yallock and Bungaree WSPAs were abolished by the Minister for Water in December 2016. Southern Rural Water can now manage these areas without the need to prepare a statutory management plan.

Table 4-7 Status of statutory management plans in groundwater catchments in 2016–17

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 14 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 2016–17

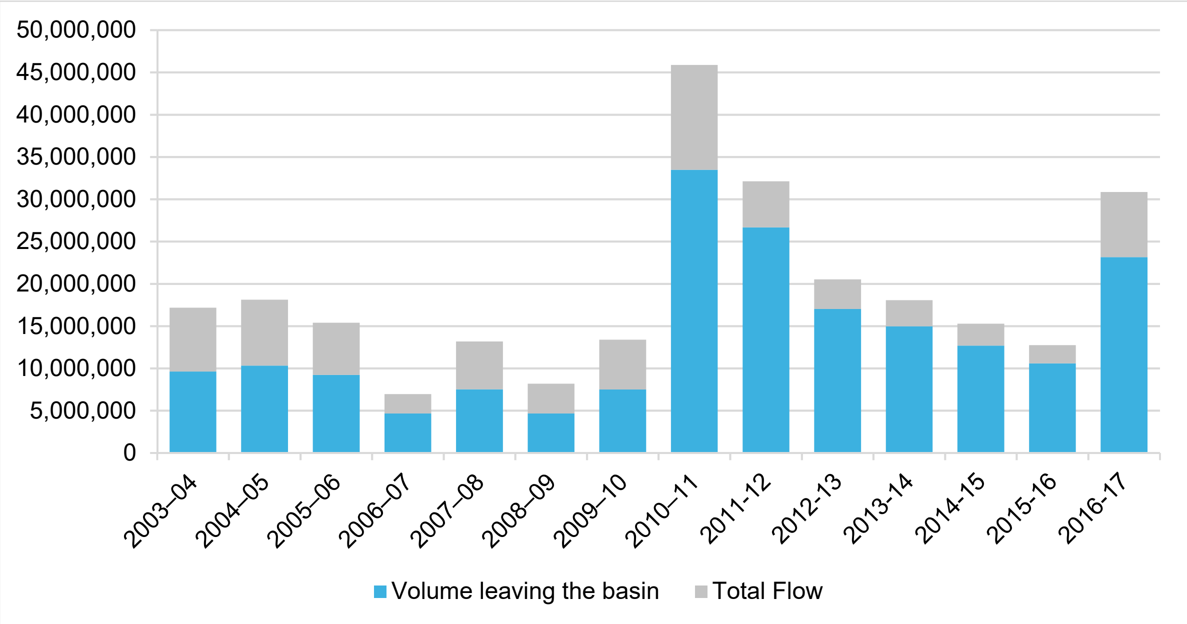


Table 4-8 shows the above cap water for each basin by reporting the total amount of water in each basin together with the amount of water that leaves the basin after water is extracted for consumptive use. The above cap water is expressed as a proportion of the annual flows of water that could have left the basin if there were no diversions. The above-average rainfall and higher river flows experienced across much of the state in 2016–17 meant that the above cap water as a total volume of water leaving Victoria's river basins was higher than the previous year (23,144,298 ML, compared to 10,577,069 ML in 2015–16). However, as a percentage of total inflow volume, the water reaching the basin outlets was lower, with 75% reaching the basin outlets in 2016–17, compared to 82% in 2015–16 (Table 4-8).

In 2016–17, the proportion of total flows leaving the basin increased in 22 of the basins and decreased in four, compared to 2015–16 (Table 4-8). The basins that experienced the lowest proportions of water leaving the basin as a percentage of total flows in 2016–17 were the Campaspe (35%), Moorabool (42%), Werribee (47%), Loddon (51%), Wimmera (55%) and Goulburn (55%) basins. The proportion of annual flows leaving the basin was 90% or above in 12 basins, predominantly in the south of the state, similar to 2015–16. Although the East Gippsland and Snowy basins recorded the highest proportion of total flows leaving the basin again in 2016–17, the volume was lower than in the previous year.

Table 4-8 Volume leaving Victorian river basins, 2016–17

Basin	Outflow to …	2016–17			2015–16		
		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	9,837,093	5,486,540	56%	2,840,189	1,580,000	56%
Kiewa (2)	Murray River	1,092,663	1,030,388	94%	473,860	426,526	90%
Ovens	Murray River	2,897,252	2,840,625	98%	713,835	648,968	91%
Broken	Murray River	543,022	477,075	88%	77,457	39,959	52%
Goulburn	Murray River	3,170,647	1,748,844	55%	1,045,733	471,160	45%
Campaspe	Murray River	445,441	153,801	35%	55,051	26,416	48%
Loddon	Murray River	575,122	292,707	51%	79,109	22,692	29%
East Gippsland	Bass Strait	590,896	589,741	100%	1,161,494	1,160,397	100%
Snowy (Vic only) (3)	Bass Strait	1,691,959	2,096,630	124%	1,927,323	2,589,593	134%
Tambo	Gippsland Lakes	358,443	352,334	98%	435,656	429,564	99%
Mitchell	Gippsland Lakes	1,060,803	1,040,558	98%	514,485	497,308	97%
Thomson	Gippsland Lakes	962,204	621,942	65%	559,704	319,934	57%
Latrobe	Gippsland Lakes	636,930	525,405	82%	552,528	473,132	86%
South Gippsland	Bass Strait, Western Port	835,065	790,595	95%	579,308	532,603	92%
Bunyip	Bass Strait, Western Port, Port Phillip Bay	622,285	562,303	90%	466,417	409,964	88%
Yarra (4)	Port Phillip Bay	751,382	471,143	63%	487,615	275,730	57%
Maribyrnong	Port Phillip Bay	136,619	114,030	83%	19,806	5,858	30%
Werribee	Port Phillip Bay	128,564	61,005	47%	21,115	5,344	25%
Moorabool	Port Phillip Bay	105,837	44,205	42%	23,457	3,202	14%
Barwon	Port Phillip Bay, Bass Strait	335,884	289,383	86%	104,820	52,158	50%
Corangamite (4)	Corangamite Lakes	388,612	375,704	97%	40,645	27,244	67%
Otway Coast	Bass Strait	938,488	905,374	96%	419,384	384,801	92%
Hopkins	Bass Strait	550,033	509,134	93%	80,845	38,985	48%
Portland Coast	Bass Strait	505,276	498,432	99%	104,323	97,297	93%
Glenelg	Bass Strait	1,336,754	1,036,754	78%	116,795	55,089	47%
Millicent Coast (5)	South Australia	4	-	-	4	-	-
Wimmera (4)	Lakes Hindmarsh and Albacutya	347,538	191,753	55%	44,378	3,146	7%
Mallee (5)	Murray River	-	-	-	-	-	-
Avoca (6)	Lake Bael Bael and the Marshes	62,597	37,894	61%	18,377	0	0%
Total		**30,907,414**	**23,144,298**	**75%**	**12,963,712**	**10,577,070**	**82%**

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 NSW 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 NSW 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 2016–17 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 2016–17 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 2016–17).

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 2016–17

5.2.1 Allocation trade

A total of 2,759,935 ML of allocation was traded in Victoria in 2016–17, an increase on 2015–16 when 2,737,236 ML was traded. Most of this occurred in northern Victoria (2,726,213 ML) with small volumes in southern Victoria (25,968 ML) and western Victoria (7,754 ML).

The continued high level of trade resulted from a combination of high volumes of allocation available and as the result of a large volume of trade late in the season to organise unused allocation for carryover into 2017–18. Trade volumes were also boosted by the volume of allocation traded by environmental water holders moving water between their environmental water accounts.

As in previous years, environmental trades made up a significant portion of the volume traded in 2016–17: there was 1,032,196 ML of within-environment allocation trade in northern Victoria (Table 5-1) which equates to 37% of the total volume traded. For information about the assumptions made to distinguish between environmental and consumptive trading, see the *Victorian Water Trading 2016–17 Annual Report*.

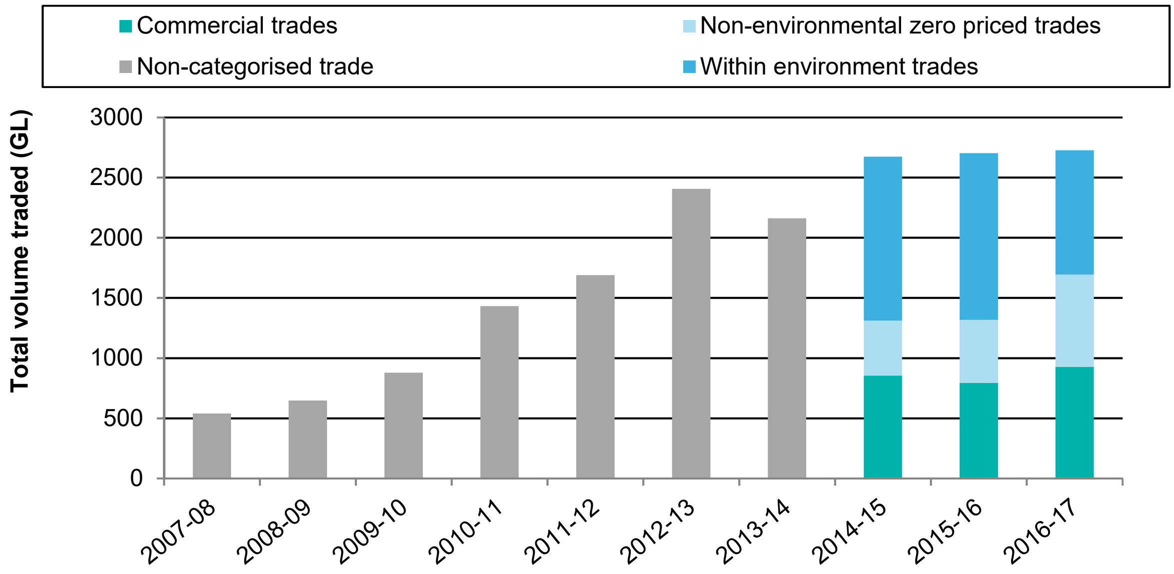
Table 5-1 Summary of trade of seasonal allocation trade in Victoria

Trade type	2016–17		2015–16	
	Number of trades	Volume (ML)	Number of trades	Volume (ML)
Northern Victoria				
Commercial trades	7,571	927,925	9,424	794,352
Zero-priced allocation trades	4,518	766,091	5,134	523,011
Within environment trades	68	1,032,196	92	1,385,059
Northern Victoria sub-total	***12,157***	***2,726,213***	***14,650***	***2,702,422***
Southern Victoria				
Commercial trades	91	4,901	497	10,985
Non-commercial trades	244	21,066	316	20,231
Southern Victoria sub-total	***335***	***25,968***	***813***	***31,216***
Western Victoria				
Commercial trades	4	7,754	4	3,598
Western Victoria sub-total	***4***	***7,754***	***4***	***3,598***
Total	**12,496**	**2,759,935**	**15,467**	**2,737,236**

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.

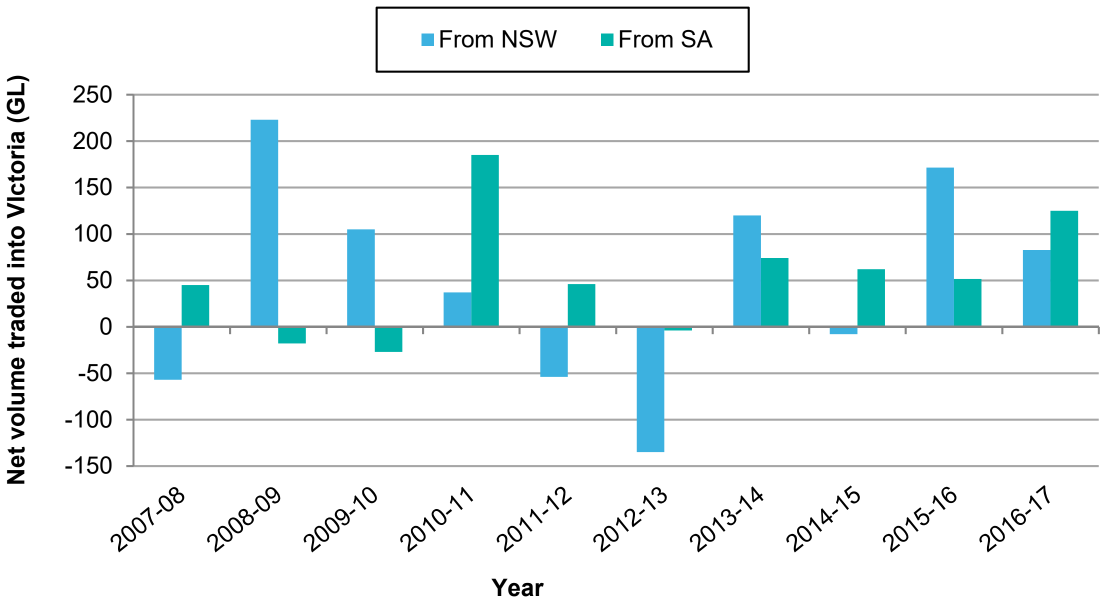
Commercial trades, where allocation is sold for a specified price, represented 927,925 ML of the total volume of allocation water traded in northern Victoria. Zero-priced trades, where water is traded from one account to another without payment, represented about 34% of the total volume traded (Figure 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, 2016–17



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 258,149 ML traded into Victoria (141,694 ML commercially) in 2016–17 and 50,684 ML traded out of Victoria (25,715 ML commercially), resulting in an overall net trade into Victoria of 207,465 ML (Figure 5-2).

Figure 5-2 Net volume of allocation trade into Victoria from New South Wales and South Australia (excluding trade within environment), 2016–17



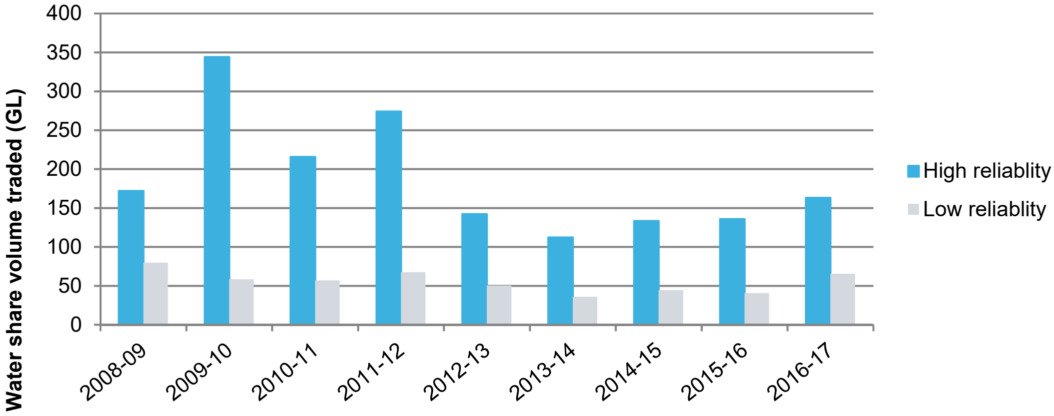
5.2.2 Water share transfers

Water share trade across Victoria in 2016–17 included 163,157 ML of high-reliability and 65,501 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	2016–17		2015–16	
	Number of trades	Volume (ML)	Number of trades	Volume (ML)
High reliability	2069	163,157	2,283	135,805
Low reliability	813	65,501	688	40,649

Figure 5-3 Transfer of ownership of water shares in Victoria, 2016–17



5.2.3 Unregulated surface water

Surface water take and use licence trading during 2016–17 resulted in 2,528 ML of water permanently traded and 3,920 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 2,104 ML of permanent trade and 2,883 ML of temporary trade. Slightly 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	27	1,037	41	424	292	4,116
South	100	2,883	42	2,104	217	5,699
West	-	-	-	-	14	380
Total 2016-17	**127**	**3,920**	**83**	**2,528**	**523**	**10,195**
Total 2015-16	**213**	**5,757**	**102**	**1,715**	**621**	**11,385**

5.2.4 Groundwater

The volume of groundwater take and use licence trading was lower in 2016–17 than in the previous year, with 11 GL of temporary trade (compared to 25,363 ML in 2015–16) and 4,323 ML of permanent trade (compared to 10,290 ML in 2015–16).

Table 5-4 shows that in 2016–17, trades of groundwater take and use licences were mostly part of land transfers (take and use licence change of ownership) with 311 trades amounting to about 45,100 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	36	2,866	32	2,033	139	19,561
South	64	3,531	28	1,544	164	23,579
West	17	4,265	3	746	8	1,960
Total 2016-17	**117**	**10,662**	**63**	**4,323**	**311**	**45,100**
Total 2015-16	**262**	**25,363**	**90**	**10,290**	**361**	**53,503**

Part 2: Water accounts 2016–17

Part 2 of the *Victorian Water Accounts 2016–17* presents an account of surface water, groundwater and distribution systems in Victoria for 2016–17.

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 enable water corporations and the community to understand where delivery-efficiency improvements to reduce losses can most readily be made.

6. Basin water accounts

6.1 Overview of methodology

6.1.1 Introduction

This chapter outlines the basis for the information presented in the basin water 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.

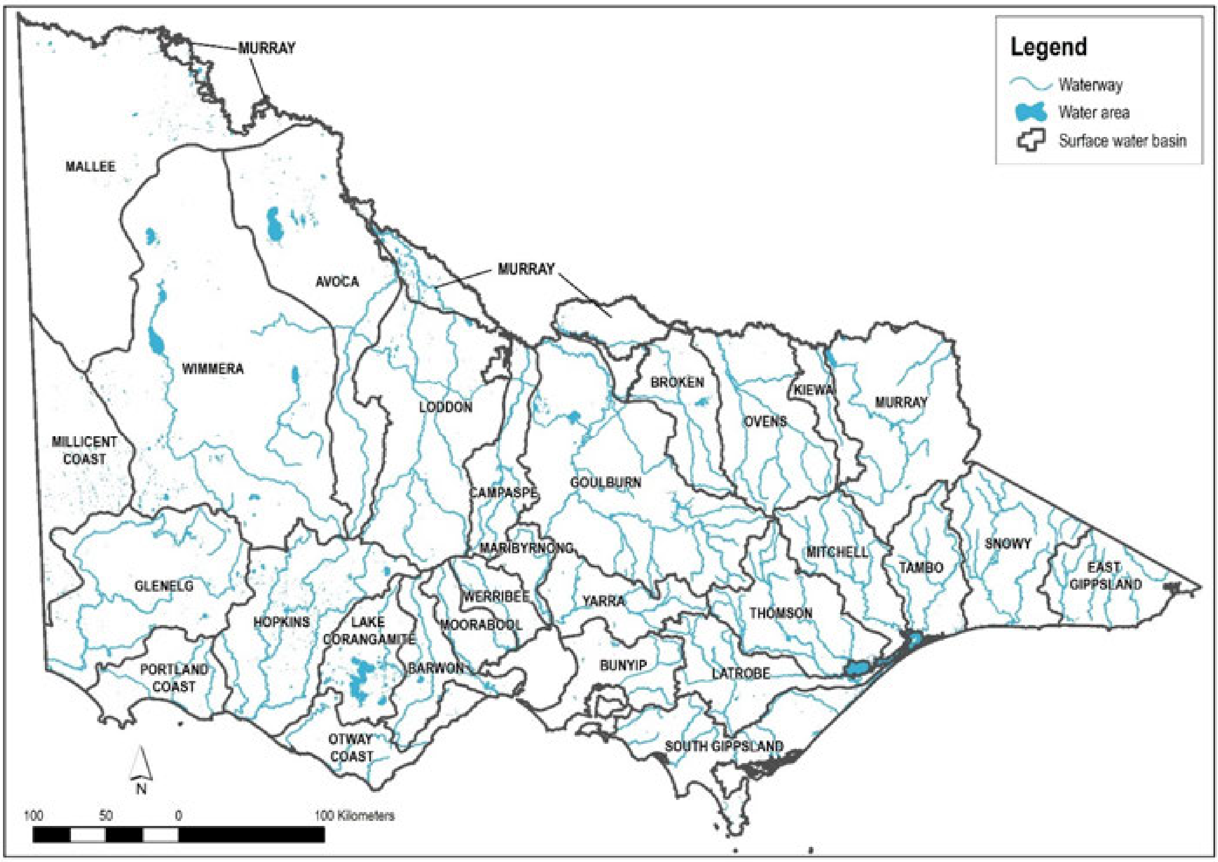
The basin water accounts are compiled from information obtained from:

- responses to requests for data from water corporations, the Victorian Environmental Water Holder (VEWH), the Department of Environment, Land, Water and Planning (DELWP), major users of water and the Murray–Darling Basin Authority (MDBA)
- water consumption and recycled water data collected from water corporations by the Essential Services Commission (ESC)
- 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 basins is provided for the period 1 July 2016 to 30 June 2017. Responsibilities for water management are reported in the accounts as they were in 2016–17. Any changes to responsibilities since the end of June 2017 will be reported in future water accounts.

As Figure 6-1 shows, 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.

Figure 6-1 River basin boundaries



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.

6.1.4 Surface water resources

Information about surface water in 2016–17 is presented in this chapter for each of the 29 river basins. There are three subchapters within each river basin section: water balance, storages and flows, and entitlement volumes and diversions.

6.1.5 Surface 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).

A surface water balance is presented for all the 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.

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 an insignificant proportion of total storage 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.

Inflows

Inflows contribute to the volume of streamflows in waterways within a basin. The inflow components included in the water balance are as follows.

- **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.
- **Rainfall on major storages:** this represents inflows from rain falling directly on major on-stream storages. Estimates are based on rainfall data and the surface area of storages.
- **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 flows from irrigation:** return flows 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 component represents the volume of water discharged from wastewater treatment plants back into waterways and is further described in chapter 6.1.10.

Outflows

This term represents water that has left a waterway, whether by natural processes (such as evaporation and seepage) or through being diverted by water corporations and individuals. The outflow components included in the water balance are as follows.

Diversions include water that is deliberately diverted from a waterway to meet a specific use and include:

- **urban diversions:** this item represents the total volume of water diverted from waterways by water corporations to supply urban customers
- **irrigation district diversions:** this component 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:** 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:** transfers to other basins represent the transfer of water to another basin where it is either used or contributes to the in-stream loss 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. Chapter 6.1.9 has more information about how the volume of extractions is determined.

Losses refer to 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 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. Chapter 6.1.9 has more information about how evaporation losses from small catchment dams is determined.
- **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 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. In-stream losses have not been estimated for basins where a suitable model is not available: these are the East Gippsland, Snowy, Tambo, Latrobe, South Gippsland, Yarra, Corangamite, Otway Coast, Hopkins and Portland Coast basins.

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.

Table 6-1 Models used to derive in-stream losses for 2016–17

Basin(s)	Model(s)
Kiewa	Kiewa River REALM [(1)]
Ovens	Ovens River REALM (the volume derived using the model represents the average annual in-stream loss over the period 1891–2006)
Broken, Goulburn, Campaspe, Loddon	Goulburn Simulation Model (this model covers the Goulburn, Broken, Campaspe and Loddon systems)
Avoca	Avon River REALM
Wimmera	Wimmera–Glenelg 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.

6.1.6 Storages and flows

A chart is presented in each basin that plots catchment inflows from the water balance 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. Information about storages in each basin is presented, 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 in or out of the storage that are not shown as rainfall or evaporation, and it may include other minor components influencing the change in storage during the year.

6.1.7 Entitlement volumes and diversions

An overview of the entitlements held by individuals or corporations in the basin is provided. The diversions by water corporations under bulk entitlements, diversions to off-stream wetlands under environmental entitlements, licensed diversions from unregulated streams by private diverters, and diversions and losses from small catchment dams are also reported.

6.1.7.1 Entitlement volumes

Details of all entitlements to water in each basin are reported. Entitlements can include rights granted to individuals (for example, water shares and take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations or the VEWH). The table 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.

6.1.8 Allocation account balance

Allocation available under bulk entitlements and licences is presented. Allocation represents the actual water that was available for use and trade in the 2016–17 water year. Individuals or authorities that held water entitlements in Victoria were allocated water based on the size of their entitlement and the available resource. For example, in 2016–17, 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 high-reliability entitlement they owned, they were allocated 20 ML of water that could be used or traded.

The tables in this chapter summarise the water transactions for each basin by entitlement holder or by entitlement holder type (that is, the total water transactions for all water share holders in a particular basin). 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 that are specified in the bulk entitlement. Where there is a difference between the total diversion from the waterway and the amount supplied to primary entitlement holders, an amount is allocated to an operating provision line item. This allows for any known or unknown loss and/or any unaccounted-for gain in the system.

Water issued and used under take and use licences is also represented as allocation in the allocation account balance tables. The 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.

6.1.9 Estimated small catchment dam information

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 (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 Victorian Water Accounts before 2015–16, the total volume of water harvested by small catchment dams was determined based on the number and volume of dams estimated using approximate methods in 2003, combined with hydrologic modelling using the best available methods in about 2005. Since that time, significant research into small catchment dams has been undertaken, and new data is available.

In 2015–16, the GIS data used to derive the capacity values for small catchment dams was updated in the accounts to provide a more-accurate measure. The new estimates of small catchment dam capacity have been used in 2016–17 and will continue to be used in future reporting in annual Victorian Water Accounts.

Estimated small catchment dam impacts are represented in the river basin water balances (Chapter 6) 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. This is calculated by multiplying the estimated total capacity by an impact factor, to make an estimate of how much water is harvested by small catchment dams over the course of a year
- 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 volume extracted (volume used in each basin) is calculated by multiplying the estimated total capacity by an extraction factor
- the estimated volume of evaporation from small catchment dams, which is accounted for as a loss in the surface water balance. This volume is determined to be the difference between the amount harvested and the amount used.

All volumes presented for small catchment dams are annual average figures. In extremely dry years, these annual average figures are factored down to reflect the reduced water availability from lower rainfall. As 2016–17 was not an extremely dry year for any of Victoria's 29 basins, the average annual volumes have been applied.

6.1.10 Recycled water

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.

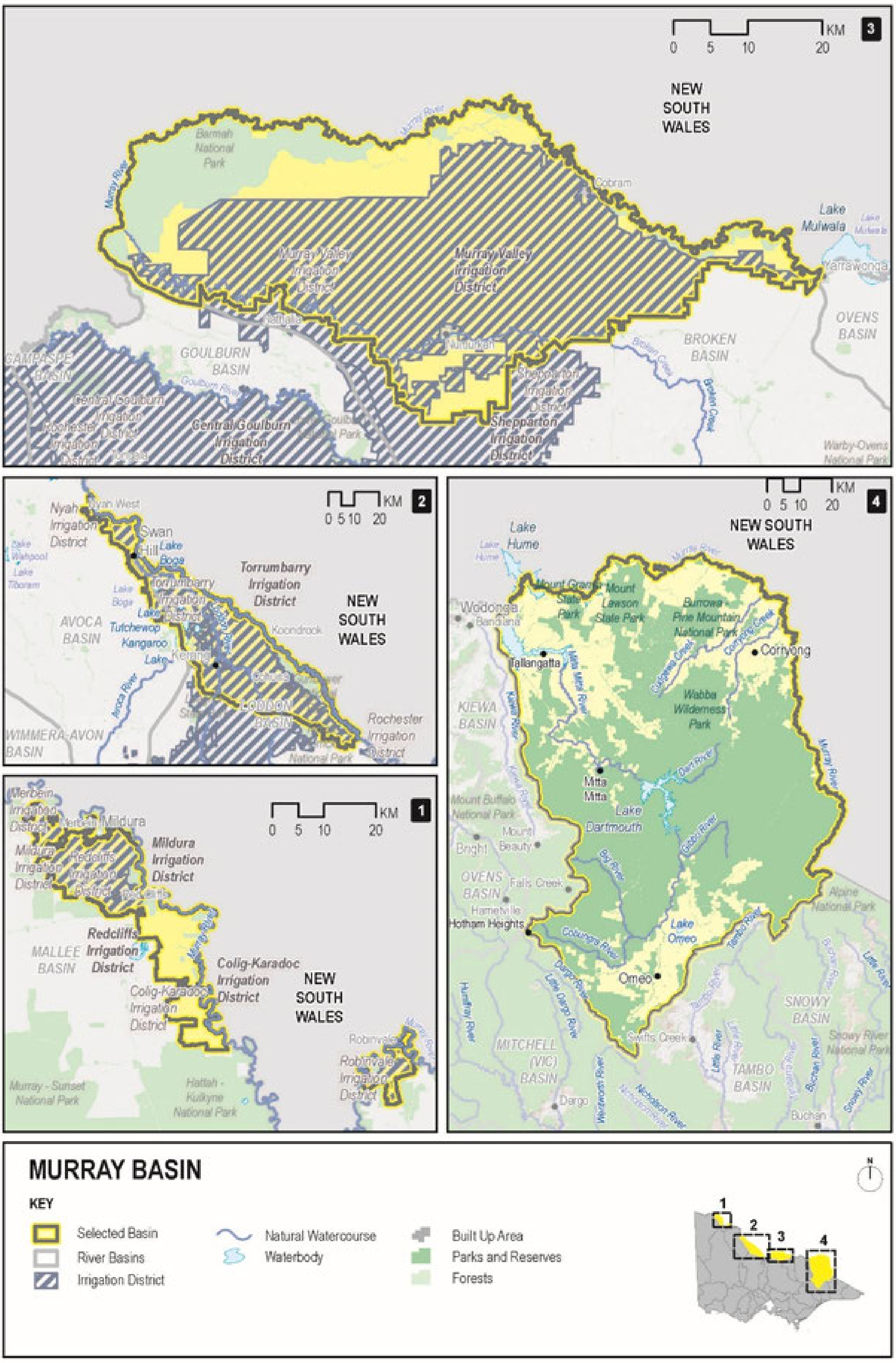
A table in each basin chapter provides information about:

- 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 Service 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: refers to the volume used to deliver specific environmental flows benefits
    - the volume recycled within plant process: 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: 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.

6.2 Murray basin (Victoria)

The Murray River forms the border with New South Wales. Victoria shares the volume of water held in the Murray–Darling basin's 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 Water resources overview

In the Murray basin in 2016–17, rainfall was between 100% and 125% of the long-term average, with a small pocket in the southernmost point of the eastern Murray basin experiencing between 80% and 100%.

Catchment inflows to the Murray basin in 2016–17 were 129% of the long-term average, much higher than in 2015–16 when inflows were 37% of the long-term average.

The volume held in Victoria's share of the major Murray system storages started at 40% of capacity at the beginning of July and was at 73% of capacity at the end of June 2017.

Seasonal allocations in the regulated Murray system began the year at 1%, and they reached 100% by February 2017. For the first time since their creation, low-reliability water shares reached 5% in February 2017.

Aside from the month of July where Waterfall (a tributary of Tallangatta Creek) had a ban on licensed diversions in place, there were no restrictions on licensed diversions from unregulated streams in the Murray basin from July to December 2016. Similar to the previous year, bans were put in place on the Indigo Creek from February 2017 to June 2017 and Black Dog Creek Upper from January to June 2017. Licensed diversions were also banned on Sandy and Lockharts creeks for March and April 2017. The Nariel Creek and lower Black Dog creeks remained unrestricted for the entire year.

Unlike the previous year, there were no urban restrictions applied in the Murray basin at all during 2016–17, with towns remaining on permanent water savings rules throughout the year.

The MDBA is responsible under the Commonwealth *Water Act 2007* for the planning and management of Murray–Darling basin water resources on behalf of Victoria, New South Wales, Queensland, the Australian Capital Territory and South Australia. Under the Murray–Darling Basin 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 shows the responsibilities of the authorities in the Victorian-controlled parts of the Murray basin.

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

Authority	Irrigation and rural water supply	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
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
Department of Environment, Land, Water and Planning (Victoria)				Coordinates Victoria's input to Murray River system operational and resource management decisions
Water NSW				Operates Lake Hume, Euston Weir and the Menindee Lakes system on behalf of the MDBA Obliged to meet passing flow requirements
South Australian Water Corporation				Operates Lake Victoria and several locks on behalf of the MDBA
Goulburn–Murray Water	Supplies Murray Valley, Torrumbarry, Woorinen, Tresco and Nyah irrigation areas	Manages private diversions on the Victorian side of the Murray upstream of Nyah		Operates Lake Dartmouth, Yarrawonga Weir (Lake Mulwala), Torrumbarry Weir and Mildura Weir on behalf of the MDBA Obliged to meet passing flow requirements
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	Obliged to meet passing flow requirements

Authority	Irrigation and rural water supply	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
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	Obliged to meet passing flow requirements
Grampians Wimmera Mallee Water			Supplies domestic and stock water to towns and farms in the northern Mallee area	
Victorian Environmental Water Holder				Holds and manages entitlements for the environment in the basin
North East Catchment Management Authority				Manages waterways in the region bounded by the Murray River in the north, the Victorian Alps in the south, the NSW border in the east and the Warby Ranges in the west
Mallee Catchment Management Authority				Manages waterways 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				Manages waterways in the region comprising the catchments of the Goulburn and Broken rivers and part of the Murray River valley
North Central Catchment Management Authority				Manages waterways 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.

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. With the exception of 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 2016–17, the Murray basin (Victoria) water for the environment comprised the following components:

- *Bulk Entitlement (River Murray – Flora and Fauna) Conversion Order 1999*, 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
- *Environmental Entitlement (River Murray – NVIRP Stage 1) 2012*, comprising 25,083 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
- 349,397ML 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
- all other water in the basin not allocated for consumptive use: this water also provides social, recreational and cultural benefits.

A total of 386,069 ML of environmental water was used in the Murray basin in 2016–17: 69,653 ML of this was diverted off-stream while the remaining 316,416 was delivered in-stream.

6.2.2 Surface water resources

6.2.2.1 Water balance

Total surface water resources include:

- 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
- outflows from the Ovens, Goulburn, Campaspe and Loddon rivers and from Broken Creek into the Murray River.

The total volumes of water available and supplied from water resources in the Murray basin in 2016–17 are shown in Table 6-3.

Table 6-3 Balance of surface water in the Murray basin (Victoria) [3]

Water account component	2016–17 (ML) (6)	2015–16 (ML) (1)
Major on-stream storage		
Volume in storage at start of year	1,839,700	2,631,426
Volume in storage at end of year	3,396,460	1,844,810
Change in storage	**1,556,760**	**(786,616)**
Inflows		
Catchment inflow (2)	9,837,093	2,840,189
Rainfall on major storages	136,400	6,858
Transfer from NSW (3)	72,980	169,940
Return flow from irrigation	292,329	296,148
Treated wastewater discharged back to river	4,248	3,690
Total inflows	**10,343,050**	**3,316,824**
Outflows		
Diversions		
Urban diversions	37,685	41,234
Irrigation district diversions	935,548	1,151,084
Licensed diversions from regulated streams	407,189	459,009
Licensed diversions from unregulated streams	3,483	3,747
Environmental water diversions	69,653	69,509
Transfer to NSW (4)	108,130	113,890
Small catchment dams	12,000	12,000
Total diversions	***1,537,688***	***1,850,472***
Losses		
Evaporation losses from major storages	429,357	127,227
Evaporation from small catchment dams	0	0
In-stream infiltration to groundwater, flows to floodplain and evaporation (5)	1,264,515	609,051
Total losses	***1,693,872***	***736,278***
Water passed at outlet of basin		
Murray River flows to South Australia from Victoria's allocation	5,486,540	1,580,000
Total water passed at outlet of basin	***5,486,540***	***1,580,000***
Total outflows	**8,786,290**	**4,103,440**

Notes

(1) Volumes for 2015–16 have been corrected from the 2015–16 published accounts.
(2) Inflows calculated based on estimates of inflows to major on-stream storages plus inflows from tributaries.
(3) Transfers from NSW include a volume of 68,480 to show the net trade adjustment from NSW to Victoria as a result of allocation trades during the year, as well as 4,500 ML to record an internal spill from NSW to Victoria in Lake Victoria.
(4) Transfers to NSW include 66,800 ML ceded to NSW under the Murray Darling Basin Agreement, and a further 2,670 ML and 2,700 ML of internal spills recorded in Hume and Lake Victoria respectively.
(5) This is the balancing item in this water balance. It is the difference between Victoria's share of the total outflows, total inflows and the net change in the storage volume.
(6) The volumes in this table may not be consistent with the MDBA's cap compliance reporting, due to different accounting entities and methods.

6.2.2.2 Storages and flows

The volume held in major storages in the Murray basin began 2016–17 at 1,952,676 ML (40% of capacity) and ended the year at 3,518,715 ML (73% of capacity) (Table 6-4). Victoria had access to a share of Menindee Lakes from

October 2016 through to the end of June 2017, when storage levels were above the trigger level specified in the Murray–Darling Basin Agreement. When storages levels are low, the available water is reserved for NSW to supply local needs.

The volume reported in the 'Catchment inflows less regulated releases' column of Table 6-4 is the balancing item for each storage. It primarily represents the flows of water in or out of the storage that are not shown as rainfall or evaporation, and it may include other minor components influencing the change in storage during the year.

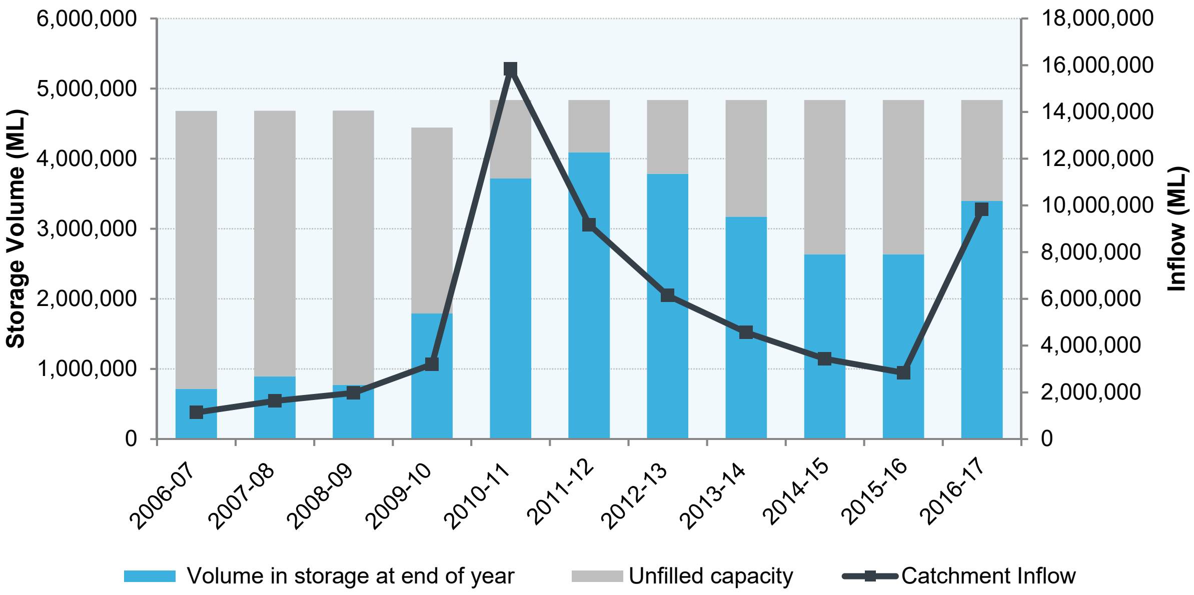
Table 6-4 Storage volumes in the Murray basin (Victoria)

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	1,046,500	23,000	19,500	641,700	1,691,700
Lake Hume (VIC share)	1,502,579	584,800	77,000	120,240	694,100	1,235,660
Lake Victoria (VIC share)	385,000	208,400	19,800	68,500	44,000	203,700
Menindee Lakes (VIC share)	865,500	0	16,600	224,200	473,000	265,400
Total on-stream storages	**4,681,195**	**1,839,700**	**136,400**	**432,440**	**1,852,800**	**3,396,460**
Off-stream storages						
Kangaroo Lake	39,200	31,180	4,329	9,480	5,251	31,280
Kow Swamp	51,710	40,527	11,473	24,957	8,726	35,769
Lake Boga	37,000	18,128	4,132	9,087	7,297	20,470
Lake Charm	22,000	18,731	2,328	5,082	14,321	30,298
Lake Cullulleraine	5,270	4,410	629	3,083	2,482	4,438
Total off-stream storages	**155,180**	**112,976**	**22,891**	**51,689**	**38,076**	**122,255**
Total storage volumes	**4,836,375**	**1,952,676**	**159,291**	**484,129**	**1,890,876**	**3,518,715**

Victoria's share of catchment inflows was 129% of the long-term average of 7,618,000 ML, much higher than in 2015–16 when catchment inflows were 37% of the long-term average (Figure 6-3).

The Victorian component of water flowing from the Murray basin to South Australia was 5,486,540 ML in 2016–17. This represented 56% of the catchment inflows into the basin, the same as in 2015–16.

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



6.2.2.3 *Entitlement volumes and diversions*

East Gippsland Water, Coliban Water, Goulburn Valley Water, North East Water, Grampians Wimmera Mallee Water, Goulburn–Murray Water, Lower Murray Water and the Melbourne metropolitan retail water corporations (City West Water, South East Water and Yarra Valley Water) all hold bulk entitlements in the Murray basin. Surface water is also diverted by licensed diverters and is harvested in small catchment dams.

Entitlements in the Murray basin include rights granted to individuals (water shares and take and use licences) and rights granted to authorities (bulk entitlements granted to water corporations or the VEWH). Rights to water in the Murray basin are outlined in Table 6-5.

Table 6-5 Entitlement volumes in the Murray basin (Victoria)

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (River Murray - Goulburn-Murray Water) Conversion Order 1999	
High-reliability water shares	929,824
Low-reliability water shares	302,432
High-reliability supply by agreements	1,134
Low-reliability supply by agreements	456
Loss provision – irrigation districts (1)	231,443
Loss provision – Victorian Mid-Murray Storages (2)	n/a
Sub-total: Bulk Entitlement (River Murray – Goulburn-Murray Water) Conversion Order 1999	**1,465,289**
Bulk Entitlement (River Murray – Lower Murray Urban and Rural Water – Irrigation) Conversion Order 1999	
High-reliability water shares	314,922
Low-reliability water shares	9,175
Millewa Waterworks district	714
Provision for statutory domestic and stock rights	532
Loss provisions (1)	15,981
Subtotal: Bulk Entitlement (River Murray – Lower Murray Urban and Rural Water – Irrigation) Conversion Order 1999	**341,325**
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	**3,492**
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 (River Murray – South East Water) Order 2012 (3)	**n/a**
Bulk Entitlement (River Murray – City West Water) Order 2012 (3)	**n/a**
Bulk Entitlement (River Murray – Yarra Valley Water) Order 2012 (3)	**n/a**
Bulk Entitlement (Corryong) Conversion Order 2000	**680**
Bulk Entitlement (Cudgewa) Conversion Order 2000	**29**
Bulk Entitlement (Dartmouth) Conversion Order 2000	**60**
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 (BMF-EWA) (4)	75,000
River Murray Increased Flows (RMIF) (5)	70,000
Subtotal: Bulk Entitlement (River Murray - Flora and Fauna) Conversion Order 1999	**364,415**
Environmental Entitlement (River Murray – NVIRP Stage 1) 2012 (6)	n/a
Bulk Entitlement (River Murray – Snowy Environmental Reserve) Conversion Order 2004	29,794
Take and use licences – unregulated surface water	16,248
Total volume of water entitlements in the Murray basin	**2,277,555**

Notes

(1) These loss provisions represent the total loss provisions 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.

(2) The provision 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).

(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 Murray water savings achieved in the previous year under the Goulburn–Murray Water Connections Project Stage 1.

(4) 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 NSW. 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. This entitlement has erroneously not been reported in the previous Victorian Water Accounts.

(5) The River Murry 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. This entitlement has erroneously not been reported in the previous Victorian Water Accounts.

(6) This entitlement provides 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 the Goulburn–Murray Water Connections Project stage 1.

n/a Specified volume is not applicable.

Allocation available under bulk entitlements and licences for 2016–17 is presented in Table 6-6. 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; 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 from major storages: 316,222 ML was written-off due to spill events in 2016–17. Water corporations' diversions under bulk entitlements for 2015–16 are presented in Table 6-6. Diversions under these 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 MDBA's website > Publications). Before this, details of this assessment were published annually in the MDBA's *Water Audit Monitoring Report.*

The VEWH diverted 69,653 ML to off-stream wetlands from water available under its entitlements.

Table 6-6 Allocation account balance summary for the Murray basin (Victoria)

Water entitlement	Opening carryover (ML)	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	Write-off due to spill (ML)	End of season forfeitures (ML)	Carryover carried forward (ML)
River Murray – Goulburn Murray Water							
Water shares	250,664	923,499	(182,232)	440,105	116,487	19,886	415,453
Supply by agreements	730	1,569	1,491	2,579	450	151	609
Loss provision - irrigation districts	-	-	-	97,307	-	-	-
Operating provisions (whole of system) (1)	-	-	-	35,101	-	-	-
Net diversion: River Murray – Goulburn-Murray Water (2)				**575,093**			
River Murray – Lower Murray Urban and Rural Water – Irrigation							
Water shares	133,643	336,691	187,344	460,399	122,096	10,801	64,381
Millewa waterworks district	0	700	100	988	0	0	(188)
Loss provision - irrigation districts	-	-	-	10,511	-	-	-
Diversion: River Murray – Lower Murray Water (3)				**471,898**			
River Murray – Lower Murray Water (Urban) (4)	8,339	30,971	(11,335)	19,704	8,339	0	(68)
River Murray – Wimmera Mallee Water	863	3,486	1,240	3,416	863	66	1,244
River Murray – North East Water (5)	4,359	14,710	(5,597)	8,947	4,359	9	158
River Murray – Goulburn Valley Water	1,897	5,593	(980)	4,491	1,897	6	116
River Murray – Coliban Water	4,855	6,285	(1,277)	4,183	4,855	41	784
River Murray – Melbourne retailers (6)	12,654	14,360	(8,975)	0	0	902	17,137
Corryong	-	680	0	251	0	429	-
Cudgewa	-	29	0	0	0	29	-
Dartmouth	-	60	0	27	0	33	-
Omeo	-	77	0	66	0	11	-
Walwa	-	61	0	17	0	44	-
River Murray – Flora and Fauna							
High and low reliability components (7)	25,647	273,955	(74,110)	192,383	16,316	5,771	11,023
Unregulated component	-	38,726	0	38,726	0	0	-
BMF-EWA	161,300	75,000	0	84,032	39,369	0	112,900
RMIF (8)	-	50,000	0	50,000	0	0	-
Subtotal: River Murray – Flora and Fauna (9)				**450,793**			
River Murray – NVIRP stage 1 (10)	11,392	15,018	18,233	20,929	0	1,186	22,528
River Murray – Snowy Environmental Reserve	1,192	29,794	(29,794)	0	1,192	0	0
Take and use licences – unregulated surface water	-	16,419	(10)	3,483	0	12,926	-
Total 2016–17	**459,914**	**1,747,969**	**(53,556)**	**1,522,196**	**276,854**	**52,409**	**538,717**
Total 2015–16	445,520	2,016,420	(543,983)	1,734,407	0	9,892	459,757

Notes

(1) 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).
(2) 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 flows from irrigation).
(3) 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.
(4) Lower Murray Water recorded an overuse of 67.6 ML on their urban bulk entitlement due to their strategy of trading all unused allocation at the end of the water season.
(5) Allocation includes return flows of 1,475 ML credited to North East Water from Wodonga recycled water treatment.
(6) Melbourne retail water corporations' entitlements are held in one account, as they each own equal shares of the available allocation.
(7) Allocation includes return flows of 229,297 ML credited to the VEWH from deliveries of environmental water.
(8) 50,000 ML of RMIF allocation was made available in 2016–17, due to substitution of state resources in the Snowy Scheme.
(9) Water use reported under this entitlement represents both in-stream use and actual diversions from the waterway. Of the 365,140 ML reported, 49,647 ML represents diversions from the waterway.

(10) Water use reported under this entitlement represents both in-stream use and actual diversions from the waterway. Of the 20,929 ML reported, 20,006 ML represents diversions from the waterway.

The estimated total capacity of and total water harvested from small catchment dams in the Murray basin is small, compared to other basins (Table 6-7). The capacity of small catchment dams for the Murray basin is estimated using GIS mapping. The GIS data used to derive the capacity values for small catchment dams was updated in 2015–16, to provide a more-accurate measure.

Table 6-7 Estimated small catchment dam information for the Murray basin (Victoria)

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	2,287	1,680	n/a
Registered commercial and irrigation	14,379	10,320	n/a
Total	**16,666**	**12,000**	**12,000 (1)**

Notes
(1) Usage and total water harvested are assumed to be equal due to the model outputting a zero loss.
n/a Information not available.

6.2.3 Recycled water

North East Water, Goulburn Valley Water, Coliban Water, Lower Murray Water and East Gippsland Water run wastewater treatment plants in the Murray basin. About 36% of wastewater passing through the treatment plants in 2016–17 was recycled, a slight decrease from 39% from 2015–16.

Table 6-8 shows the volumes and uses of recycled water in the Murray basin in 2016–17. Where water has been recycled within the plant process, this volume has not been included in the percent recycled value.

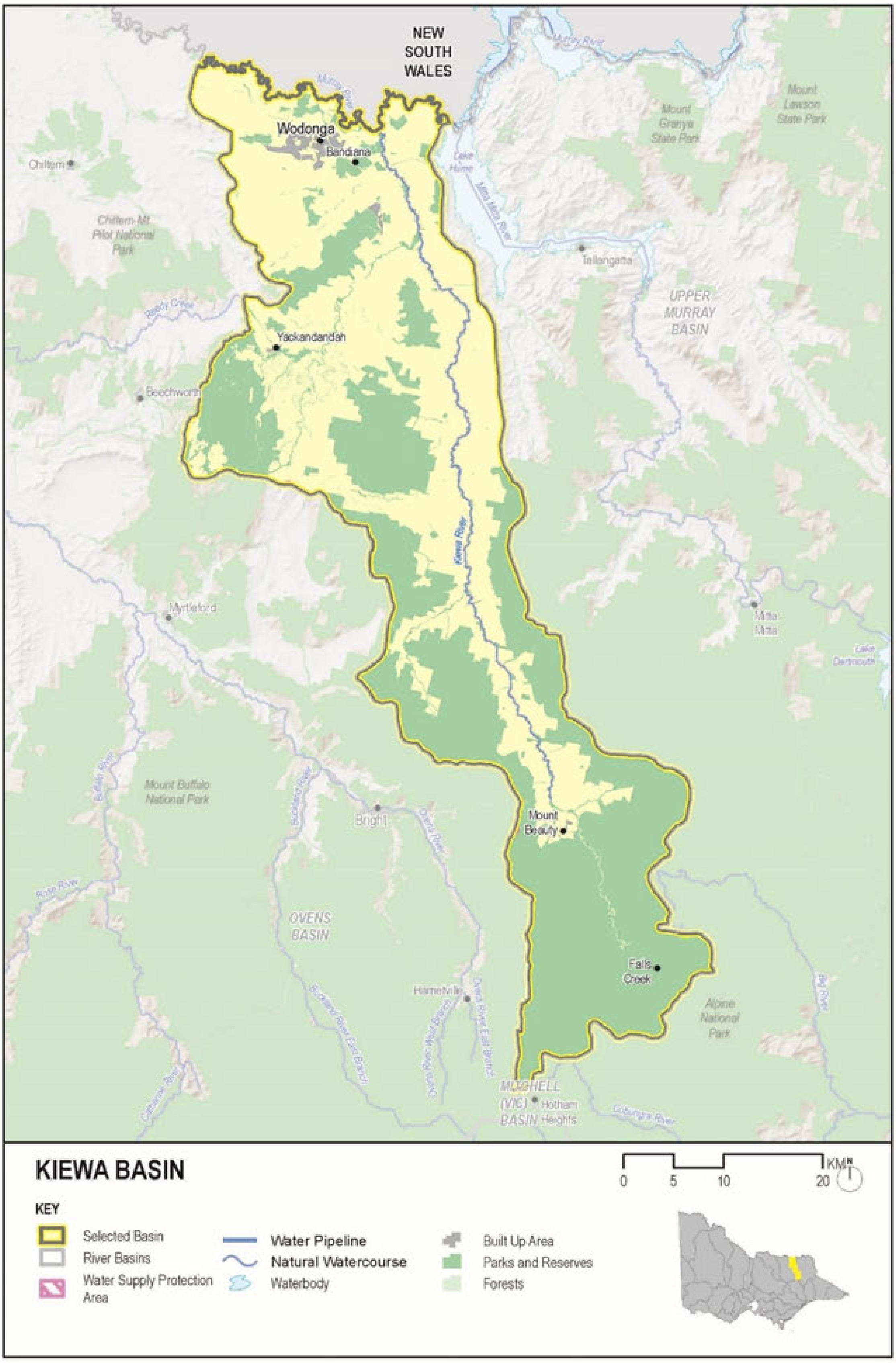
Table 6-8 Volume and use of recycled water in the Murray basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled (excludes within plant process)	Type of end use (ML)				Volume discharged to the environment	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Bellbridge	46	46	100%	0	46	0	0	0	0
Bundalong	0	0	0%	0	0	0	0	0	0
Cobram	270	270	100%	0	270	0	0	0	0
Cohuna	0	0	0%	0	0	0	0	0	0
Corryong	56	56	100%	0	56	0	0	0	0
Dartmouth	4	0	0%	0	0	0	0	4	0
Gunbower / Leitchville	17	17	100%	0	17	0	0	0	0
Koondrook	97	0	0%	0	0	0	0	0	97
Koorlong	1,881	1,804	96%	0	1,804	0	0	0	77
Lake Boga	47	0	0%	0	0	0	0	0	47
Merbein	148	0	0%	0	0	0	0	0	148
Mildura	1,725	635	37%	0	635	0	0	115	975
Murrabit	6	0	0%	0	0	0	0	0	6
Nathalia	176	146	83%	0	146	0	0	30	0
Numurkah	180	120	67%	0	120	0	0	60	0
Nyah / Nyah West	73	0	0%	0	0	0	0	0	73
Omeo	35	35	100%	0	35	0	0	0	0
Robinvale	241	183	76%	0	183	0	0	0	58
Strathmerton	0	0	0%	0	0	0	0	0	0
Swan Hill	1,241	0	0%	0	0	0	0	0	1,241
Tallangatta	91	91	100%	0	91	0	0	0	0
Walwa	6	6	100%	1	5	0	0	0	0
Wodonga	4,275	237	3%	136	0	0	101	4,039	0
Yarrawonga	435	435	100%	0	435	0	0	0	0
Total 2016–17	**11,050**	**4,081**	**36%**	**137**	**3,843**	**0**	**101**	**4,248**	**2,722**
Total 2015–16	10,097	4,026	39%	178	3,733	0	114	3,690	2,379

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, draining northward to the Murray River.

Figure 6-4 Map of the Kiewa basin



6.3.1 Water resources overview

In 2016–17, the entire Kiewa basin received between 100% and 125% of the long-term average rainfall.

Catchment inflows were 159% of the long-term average, more than double the 69% in 2015–16. The volume of water flowing out of the Kiewa River into the Murray basin represented 94% of the Kiewa basin's total inflows.

Although the rainfall and inflows for 2016–17 were above average, some of the northern parts of Victoria received low inflows and the lowest rainfall on record in June 2017. This contributed to the major water storages in the Kiewa basin finishing the year at 47% of capacity, compared to 62% of capacity at the start of the year.

There were no restrictions to licensed diversions in unregulated streams from August to December 2016. Basin and Bight Creek had licensed diversions bans applied from January, with five other streams bringing the peak total to seven from March to May 2017, three less than the peak last year. By the end of June 2017, licensed diversions remained restricted on Bay and Bight creeks.

No urban water use restrictions applied in the Kiewa basin in 2016–17, with all towns remaining on permanent water-saving rules throughout the year.

Table 6-9 shows the responsibilities of the authorities in the Kiewa basin.

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

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Goulburn–Murray Water	Manages private diversions		Obliged to meet passing flow requirements
North East Water		Supplies towns across the basin including Wodonga and Mount Beauty	Obliged to meet passing flow requirements
AGL Hydro			Operates reservoirs in the Kiewa basin for hydropower generation Obliged to meet passing flow requirements
North East Catchment Management Authority			Manages waterways in the region bounded by the Murray River in the north, the Victorian Alps in the south, the NSW border in the east and the Warby Ranges in the west

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 2016–17, 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.

6.3.2 Surface water resources

6.3.2.1 Water balance

The total volumes of water available and supplied from water resources in the Kiewa basin in 2016–17 are shown in Table 6-10. Outflows from the Kiewa basin are shared on a 50-50 basis between Victoria and New South Wales in the Murray system.

Outflows from the Kiewa basin were higher in 2016–17 (Table 6-10) than those reported in the *Victorian Water Accounts 2015–16*. Only a small proportion of the surface water resources in the Kiewa basin (1.1%) was extracted for consumptive use, which is slightly lower than 2015–16 (2.6%).

Table 6-10 Balance of surface water in the Kiewa basin

Water account component	2016–17 (ML)	2015–16 (ML)
Major on-stream storage		
Volume in storage at start of year	18,473	15,548
Volume in storage at end of year	13,704	18,473
Change in storage	**(4,769)**	**2,925**
Inflows		
Catchment inflow (1)	1,092,663	473,860
Rainfall on major storages	3,888	3,815

Treated wastewater discharged back to river [2]	388	310
Total inflows	**1,096,939**	**477,985**
Outflows		
Diversions		
Urban diversions	489	527
Licensed diversions from unregulated streams	4,071	4,571
Small catchment dams	7,440	7,440
Total diversions	***12,000***	***12,538***
Losses		
Evaporation losses from major storages	2,421	2,895
Losses from small catchment dams	1,963	1,963
In-stream infiltration to groundwater, flows to floodplain and evaporation	54,936	31,138
Total losses	***59,320***	***35,996***
Water passed at outlet of basin		
Kiewa basin outflow to Murray River - Victoria share	515,194	213,263
Kiewa basin outflow to Murray River - NSW share	515,194	213,263
Total water passed at outlet of basin	***1,030,388***	***426,526***
Total outflows	**1,101,708**	**475,060**

Notes

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

(2) Includes returns from the Falls Creek Alpine Resort to Rocky Valley Creek.

6.3.2.2 Storages and flows

Storage levels for all major on-stream and off-stream storages in the basin were 14,176 ML (47% of capacity) by the end of June 2017, compared to 18,888 ML (62% of capacity) at the start of July 2016 (Table 6-11). The volume reported in the 'Catchment inflows less regulated releases' column is the balancing item for each storage. It represents the flows of water in or out of the storage that are not shown as rainfall or evaporation, and it may include other minor components influencing the change in storage during the year.

Table 6-11 Storage volumes in the Kiewa basin

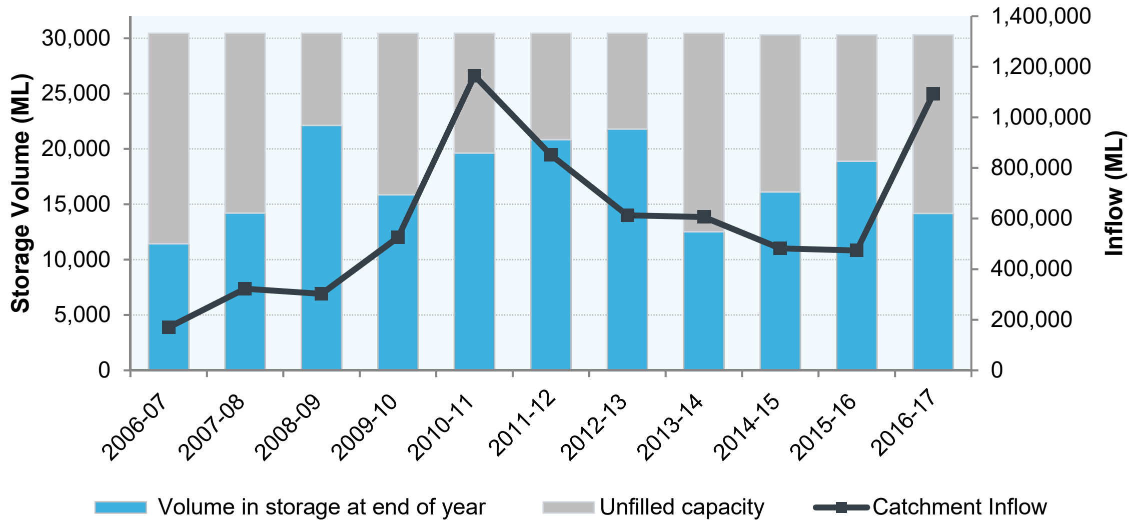
Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Lake Guy	1,416	359	210	131	132	570
Rocky Valley	28,294	18,114	3,678	2,290	(6,368)	13,134
Total on-stream storages	**29,710**	**18,473**	**3,888**	**2,421**	**(6,236)**	**13,704**
Off-stream storages						
Clover Pondage	255	60	n/a	n/a	57	117
Pretty Valley basin	355	355	n/a	n/a	0	355
Total off-stream storages	**610**	**415**	**n/a**	**n/a**	**57**	**472**
Total storage volumes	**30,320**	**18,888**	**3,888**	**2,421**	**(6,179)**	**14,176**

n/a Information not available.

The catchment inflow volume for 2016–17 was 1,092,663 ML, representing 159% of the long-term average of 689,000 ML. The volume of water flowing from the Kiewa basin into the Murray River increased to 1,030,388 ML in 2016–17 (including the New South Wales share of Kiewa River flows under the Murray–Darling Basin Agreement). This volume was 603,862 ML more than the 2015–16 outflow volume of 426,526 ML. The volume of water flowing from the Kiewa basin into the Murray River in 2016–17 represented 94% of the total inflows into the Kiewa basin, which is higher than the percentage of inflows in the previous year (90%).

Figure 6-5 illustrates total storage volume and catchment inflows for 2016–17, compared to the previous 10 years.

Figure 6-5 Storage volumes and catchment inflows



6.3.2.3 Entitlement volumes and diversions

In the Kiewa basin, surface water is diverted by North East Water and licensed diverters, and water is harvested in small catchment dams.

Entitlements include rights granted to individuals (water shares and take and use licences) and rights granted to authorities (bulk entitlements granted to water corporations or the VEWH). Rights to water in the Kiewa basin are in Table 6-12.

Table 6-12 Entitlement volumes in the Kiewa basin

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (Kiewa - Hydro) Conversion Order 1997 (1)	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	15,510
Total volume of water entitlements in the Kiewa basin	**16,616**

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.

n/a Specified volume is not applicable.

Allocation available under bulk entitlements and licences for 2016–17 is presented in Table 6-13. Diversions under these 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 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. All unused seasonal allocation water is therefore forfeited at the end of the season.

Table 6-13 Allocation account balance summary for the Kiewa basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Kiewa - Hydro (1)	-	-	-	-
Kiewa – Tangambalanga	179	0	0	179
Mount Beauty – Tawonga	718	0	275	443
Yackandandah	209	0	214	(5)
Take and use licences - unregulated surface water	15,591	0	4,071	11,520
Total 2016–17	**16,697**	**0**	**4,560**	**12,137**
Total 2015–16	16,738	20	5,098	11,660

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.

The estimated volume of water harvested from small catchment dams in the Kiewa basin is shown in Table 6-14. The capacity of small catchment dams for Kiewa basin is estimated using GIS mapping. The GIS data used to derive the capacity values for small catchment dams was updated in 2015–16, to provide a more-accurate measure.

Table 6-14 Estimated small catchment dam information for the Kiewa basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	7,157	3,579	n/a
Registered commercial and irrigation	4,597	3,861	n/a
Total	**11,754**	**7,440**	**9,403**

n/a Information not available.

6.3.3 Recycled water

North East Water and East Gippsland Water operate wastewater treatment plants in the Kiewa basin. About 36% of wastewater was recycled in 2016–17, a slight decrease from the estimated 41% in 2015–16. In addition, 128 ML was returned from the Falls Creek Alpine Resort to Rocky Valley Creek during the water year.

Table 6-15 shows the volumes and uses of recycled water in the Kiewa basin in 2016–17. Where water has been recycled within the plant process, this volume has not been included in the percent recycled value.

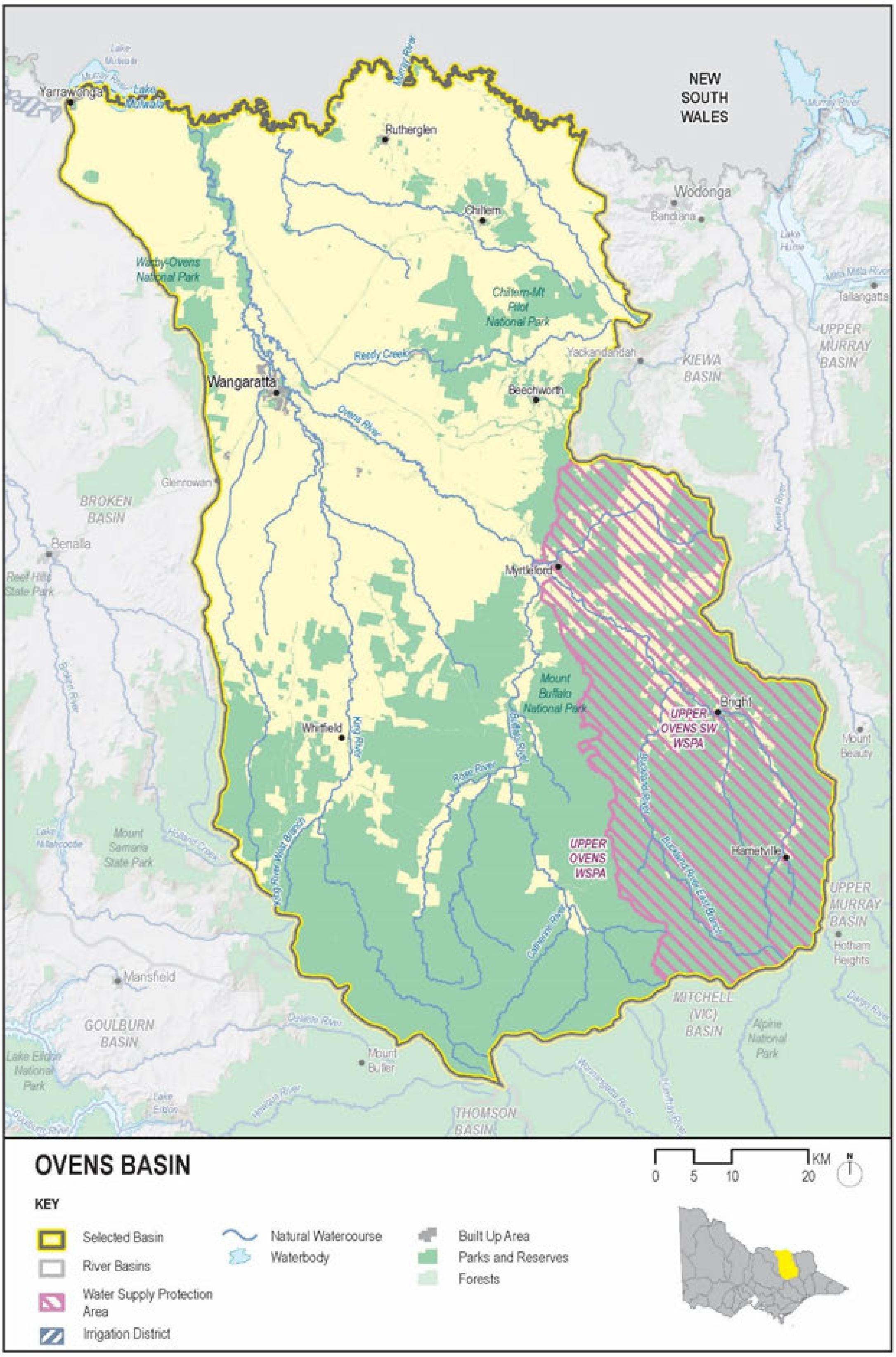
Table 6-15 Volume and use of recycled water in the Kiewa basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled (excludes within plant process)	Type of end use (ML)				Volume discharged to the environment	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	80	80	100%	0	80	0	0	0	0
Mount Beauty	264	5	2%	5	0	0	0	260	0
Yackandandah	61	61	100%	0	61	0	0	0	0
Total 2016–17	**405**	**146**	**36%**	**5**	**141**	**0**	**0**	**260**	**0**
Total 2015–16	321	132	41%	8	124	0	0	189	0

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 Water resources overview

In 2016–17, rainfall across the Ovens basin was between 100% to 125% of the long-term average.

Catchment inflows in 2016–17 were 165% of the long-term average annual volume: around four times more than the 41% from the previous year. The volume of water flowing out of the Ovens basin into the Murray River represented 98% of the Ovens basin's total inflows.

The total volume of water held in major storages in the Ovens basin finished the year at 69% of capacity, lower than they began at the start of the year at 77%.

Licensed diversions on all unregulated streams were unrestricted from July 2016 through to January 2017. Above-average rainfall in late 2016 contributed to licensed diversion restrictions being imposed on only five streams, compared to 23 the previous year. The stage 2 restrictions on 15 Mile Creek in February were raised to stage 4 in March and lifted after May 2017. Hurdle, Reedy and Scrubby creeks had restrictions in place from March to May, and the restriction on Roberts Creek imposed in March continued through to June 2017.

No urban water use restrictions were applied in the Ovens basin in 2016–17, with all towns remaining on permanent water savings rules throughout the year.

Table 6-16 shows the responsibilities of the authorities in the Ovens basin.

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

Authority	Irrigation and rural water supply	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Goulburn–Murray Water	Supplies primary entitlements on the regulated Ovens and King system	Manages licensed diversions		Operates Lake Buffalo and Lake William Hovell Obliged to meet passing flow requirements
North East Water			Supplies towns including Wangaratta, Bright, Myrtleford, Beechworth and Chiltern	Obliged to meet passing flow requirements
North East Catchment Management Authority				Manages waterways in the region bounded by the Murray River in the north, the Victorian Alps in the south, the NSW border in the east and the Warby Ranges in the west

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, 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 2016–17, 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 on 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 2016–17, 123 ML of environmental water was delivered in-stream in the Ovens basin.

6.4.2 Surface water resources

6.4.2.1 Water balance

The total volumes of water available and supplied from water resources in the Ovens basin in 2016–17 are shown in Table 6-17. The volume of surface water resources in 2016–17 increased to 2,904,197 ML, compared to 719,258 ML in 2015–16. Total water use was less than the previous year, with total use of 38,998 ML in 2016–17, compared to 41,827 ML in 2015–16.

Table 6-17 Balance of surface water in the Ovens basin

Water account component	2016–17 (ML)	2015–16 (ML)
Major on-stream storage		
Volume in storage at start of year	28,512	28,035
Volume in storage at end of year	25,602	28,512
Change in storage	**(2,910)**	**477**
Inflows		
Catchment inflow [(1)]	2,897,252	713,835
Rainfall on major storages	4,664	3,663
Treated wastewater discharged back to river	2,281	1,690
Total inflows	**2,904,197**	**719,188**
Outflows		
Diversions		
Urban diversions	5,581	5,582
Licensed diversions from regulated streams	5,922	8,086
Licensed diversions from unregulated streams	3,741	4,405
Small catchment dams	23,754	23,754
Total diversions	***38,998***	***41,827***
Losses		
Evaporation losses from major storages	3,364	3,796
Evaporation from small catchment dams	9,184	9,184
In-stream infiltration to groundwater, flows to floodplain and evaporation	14,936	14,936
Total losses	***27,484***	***27,916***
Water passed at outlet of basin		
Ovens basin outflow to Murray River	2,840,625	648,968
Total water passed at outlet of basin	***2,840,625***	***648,968***
Total outflows	**2,907,106**	**718,711**

Note

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

6.4.2.2 Storages and flows

The total volume of water held in major storages in the Ovens basin was 28,512 ML (or 77% of capacity) at 1 July 2016 and 25,602 ML (or 69% of capacity) by the end of June 2017 (Table 6-18). The volume reported in the 'Catchment inflows less regulated releases' column in Table 6-18 is the balancing item for each storage. It represents the flows of water in or out of the storage that are not shown as rainfall or evaporation, and it may include other minor components influencing the change in the volume in storage during the year.

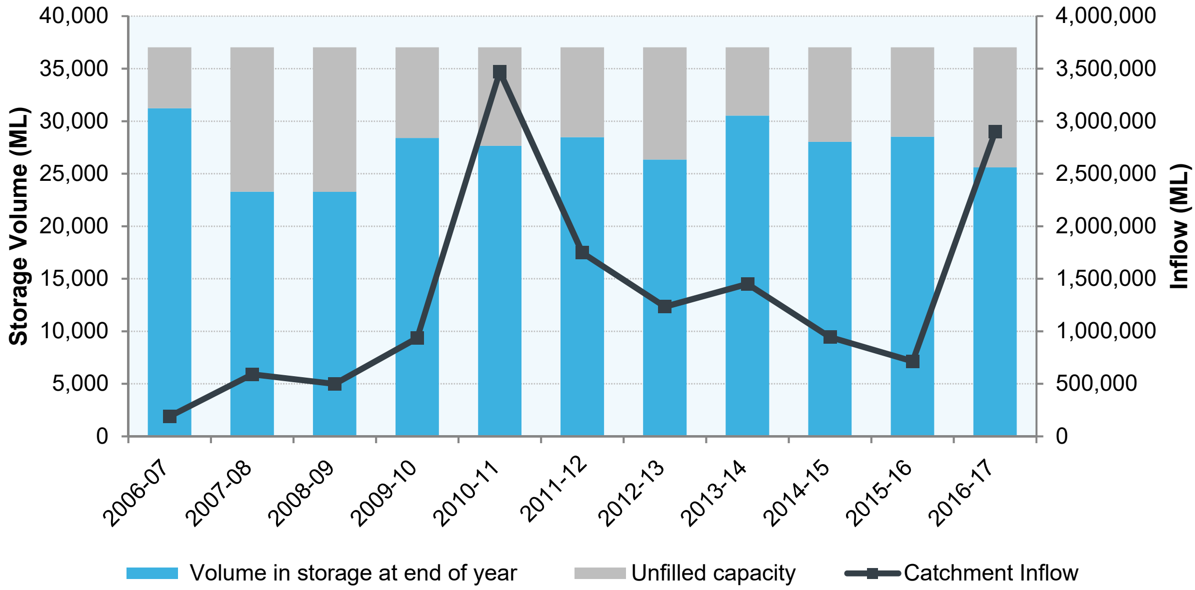
Table 6-18 Storage volumes in the Ovens basin

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	14,657	3,132	2,638	(2,004)	13,147
Lake William Hovell	13,690	13,855	1,532	726	(2,206)	12,455
Total storage volumes	**37,030**	**28,512**	**4,664**	**3,364**	**(4,210)**	**25,602**

Catchment inflows in 2016–17 were 165% of the long-term annual average (2,897,252 ML), compared to 41% in 2015–16. The volume of water flowing from the Ovens basin into the Murray River was 2,840,625 ML in 2016–17. This represented 98% of the total inflows into the basin, compared to 90% in 2015–16.

Figure 6-7 shows the storage levels and inflow volumes in the Ovens basin from 2006–07 to 2016–17.

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



6.4.2.3 Entitlement volumes and diversions

In the Ovens basin, water is diverted by Goulburn–Murray Water, North East Water and licensed diverters, and water is harvested in small catchment dams.

Entitlements in the Ovens basin include rights granted to individuals (for example, water shares and take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations or the VEWH). Rights to water in the Ovens basin are outlined in Table 6-19.

Table 6-19 Entitlement volumes in the Ovens basin

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (Ovens System - Goulburn-Murray Water) Conversion Order 2004 (1)	
High-reliability water shares	26,200
Spill-reliability water shares	12,519
Bulk Entitlement (Ovens System - Moyhu, Oxley and Wangaratta - North East Water) Conversion Order 2004	7,832
Sub-total: Bulk Entitlement (Ovens System - Goulburn-Murray Water) Conversion Order 2004	**46,551**
Bulk Entitlement (Beechworth) Conversion Order 2001	1,100
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	17,022
Total volume of water entitlements in the Ovens basin	**67,444**

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 Wangaratta, Oxley and Moyhu.

(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).

Allocation available under bulk entitlements and licences for 2016–17 is presented in Table 6-20. Diversions under these 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 MDBA's website > Publications). Before this, details of this assessment were published annually in the MDBA's *Water Audit Monitoring Report.*

Table 6-20 Allocation account balance summary for the Ovens basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Ovens system - Goulburn-Murray Water				
Water shares (1)	38,719	0	5,922	32,797
Ovens system - Moyhu, Oxley and Wangaratta	7,832	0	3,578	4,254
Diversion: Ovens system - Goulburn-Murray Water (2)			**9,430**	
Beechworth	1,100	0	527	573
Bright	870	0	869	1
Chiltern (3)	180	0	0	180
Glenrowan (4)	90	0	0	90
Harrietville	91	0	58	33
Myrtleford	1,470	0	532	938
Springhurst	36	0	0	36
Whitfield	34	0	17	17
Take and use licences - unregulated surface water (5)	17,326	245	3,741	13,830
Total 2016–17	**67,748**	**245**	**15,174**	**52,748**
Total 2015–16	57,055	511	18,142	39,423

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 does not include 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 245 ML represents water traded in from the Upper Ovens GMU.

The estimated volume of water harvested from small catchment dams represents the largest diversion of surface water in the Ovens basin (Table 6-21). The capacity of small catchment dams for the Ovens basin is estimated based on GIS mapping. The GIS data used to derive the capacity values for small catchment dams was updated in 2015–16, to provide a more-accurate measure.

Table 6-21 Estimated small catchment dam information for the Ovens basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	29,375	14,688	n/a
Registered commercial and irrigation	10,793	9,066	n/a
Total	**40,168**	**23,754**	**32,938**

n/a Information not available.

6.4.3 Recycled water

North East Water operates all wastewater treatment plants in the Ovens basin. About 31% of the wastewater was recycled in 2016–17, lower than the estimated 41% in 2015–16.

Table 6-22 shows the volumes and uses of recycled water in the Ovens basin in 2016–17. Where water has been recycled within the plant process, this volume has not been included in the percent recycled value.

Table 6-22 Volume and use of recycled water in the Ovens basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled (excludes within plant process)	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	337	72	21%	0	72	0	0	265	0
Bright / Porepunkah	398	19	5%	19	0	0	0	379	0
Chiltern	27	27	100%	0	27	0	0	0	0
Glenrowan	24	24	100%	0	24	0	0	0	0
Myrtleford	379	0	0%	0	0	0	0	379	0

Rutherglen / Wahgunyah	119	119	100%	53	66	0	0	0	0
Wangaratta	1,800	749	42%	0	749	0	0	1,051	0
Wangaratta Trade Waste	207	0	0%	0	0	0	0	207	0
Total 2016–17	**3,291**	**1,010**	**31%**	**72**	**938**	**0**	**0**	**2,281**	**0**
Total 2015–16	2,861	1,172	41%	93	1,079	0	0	1,690	0

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 Water resources overview

In 2016–17, rainfall across most of the Broken basin was 100% to 125% of the long-term average, except for a small portion to the south which was 80% to 100% of the long-term average.

Total catchment inflows were 176% of the long-term average of 308,000 ML, much higher than the previous year, which had inflows of 25% of the long-term average.

Major storages in the Broken basin were at 78% of capacity at the end of the 2016–17, after being at 32% of capacity at the start.

The first seasonal determination for high-reliability water shares of 20% was announced on 1 August 2016 and increased to 100% on 1 September 2016. After above-average rainfall, a seasonal determination for low-reliability water shares of 14% was made on 14 September 2016, and it reached 100% on 15 November 2016.

A licensed diversion ban was in place on Boosey Creek from January until June 2017. Hollands Creek and Ryans Creek were also subject to bans from early December to June 2016. The Lima and Lima East creeks remained unrestricted in 2016–17. There were no restrictions on urban water use in the Broken basin during 2016–17, with all towns remaining on permanent water-saving rules throughout the year.

Table 6-23 shows the responsibilities of the authorities within the Broken basin.

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

Authority	Irrigation and rural water supply	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
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 (1) and North East Water	Operates Lake Nillahcootie and weirs on Broken River Obliged to meet passing flow requirements
North East Water			Supplies towns across most of the Broken basin including Benalla	Operates Loombah-McCall Say Reservoir Obliged to meet passing flow requirements
Goulburn Valley Water			Supplies towns in the west of the basin including Shepparton, Nathalia and Dookie (1)	
Goulburn Broken Catchment Management Authority				Manages waterways in the region comprising of the catchments of the Goulburn and Broken rivers and part of the Murray River valley

Note

(1) Urban water systems managed by Goulburn Valley Water in the Broken basin are supplied water from the Goulburn and Murray systems.

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 Broken Creek and lower Broken Creek 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 2016–17, 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
- 253 ML of high-reliability water shares and 4 ML low-reliability water shares held for the environment.

6.5.2 Surface water resources

6.5.2.1 Water balance

The total volumes of water available and supplied from water resources in the Broken basin in 2016–17 are shown in Table 6-24.

The amount of water flowing from the Broken basin into the Goulburn and Murray rivers increased to 477,075 ML in 2016–17, compared to 39,959 ML in 2015–16.

Table 6-24 Balance of surface water in the Broken basin

Water account component	2016–17 (ML)	2015–16 (ML)
Major on-stream storage		
Volume in storage at start of year	13,562	23,060
Volume in storage at end of year	32,877	13,562
Change in storage	**19,315**	**(9,498)**
Inflows		
Catchment inflow [(1)]	543,022	77,457
Rainfall on major storages	4,741	2,137
Total inflows	**547,763**	**79,594**
Outflows		
Diversions		
Urban diversions	1,494	1,538
Licensed diversions from regulated streams	7,738	8,296
Licensed diversions from unregulated streams	514	764
Environmental water diversions	0	500
Small catchment dams	16,766	16,766
Total diversions	***26,511***	***27,864***
Losses		
Evaporation losses from major storages	4,669	3,459
Evaporation from small catchment dams	8,625	8,625
In-stream infiltration to groundwater, flows to floodplain and evaporation	11,568	9,185
Total losses	***24,862***	***21,269***
Water passed at outlet of basin		
Broken River at Gowangardie to Goulburn basin	374,310	38,514
Boosey Creek at Tungamah to Murray basin	76,694	346
Broken Creek at Katamatite to Murray basin	26,070	1,099
Total water passed at outlet of basin	***477,075***	***39,959***
Total outflows	**528,448**	**89,092**

Note

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

6.5.2.2 Storages and flows

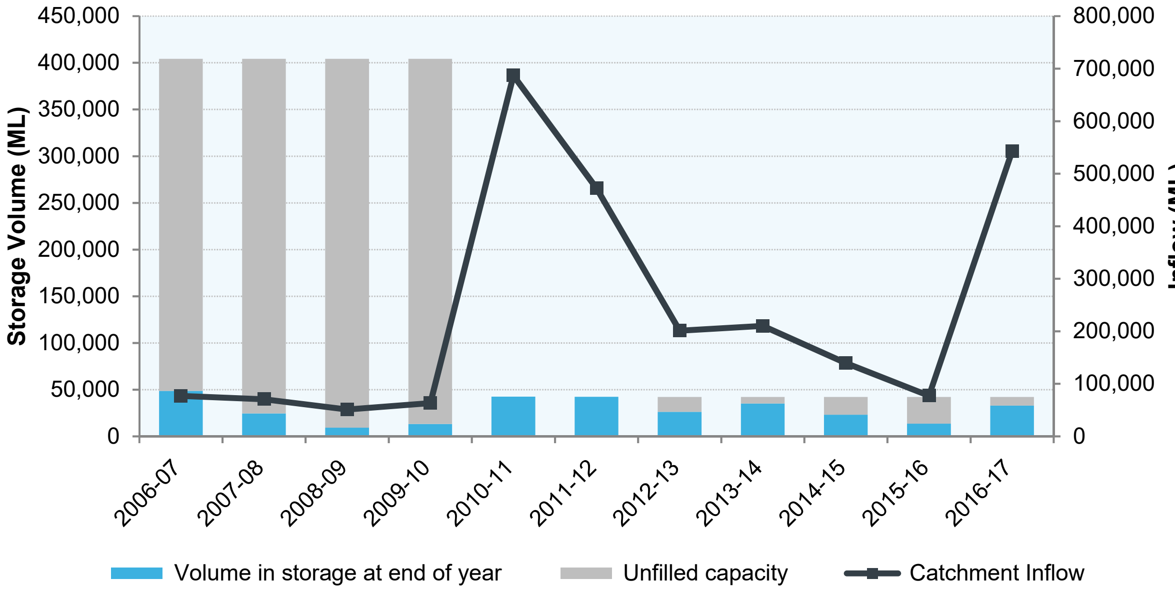
The volume of water held in major storages in the Broken basin was 32,877 ML at the end of June 2017, more than double the storage volume at the start of the year (Table 6-25). The volume reported in the 'Catchment inflows less regulated releases' column in the table is the balancing item for each storage. It represents the flows of water in or out of the storage that are not shown as rainfall or evaporation, and it may include other minor components influencing the change in storage during the year.

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	11,815	4,342	3,907	18,880	31,130
Loombah-McCall Say	1,747	1,747	399	762	363	1,747
Total storage volumes	**42,147**	**13,562**	**4,741**	**4,669**	**19,243**	**32,877**

Catchment inflows were 176% (543,022 ML) of the long-term average of 308,000 ML, much higher than the 25% (77,457 ML) recorded in 2015–16 (Figure 6-9).

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



Note

(1) Before 2010–11, Lake Mokoan was included as a storage in the Broken basin. Lake Mokoan was decommissioned in 2010 and water supply from this storage ceased. It is therefore no longer included in the total storage capacity for Broken basin.

6.5.2.3 Entitlement volumes and diversions

In the Broken basin, surface water is harvested or diverted by Goulburn–Murray Water, North East Water, and licensed diverters, and water is harvested in small catchment dams.

Entitlements in the Broken basin include rights granted to individuals (for example, water shares and take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations). Rights to water in the Broken basin are outlined in Table 6-26.

Table 6-26 Entitlement volumes in the Broken basin

Water entitlements	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
Loss provision	1,850
Sub-total: 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	2,718
Total volume of water entitlements in the Broken basin	**27,997**

Note

(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.

Allocation available under bulk entitlements and licences for 2016–17 is presented in Table 6-27. 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; any unused water above this amount is written-off (end-of-season forfeiture).

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 MDBA's website > Publications). Before this, details of this assessment were published annually in the MDBA's *Water Audit Monitoring Report.*

Table 6-27 Allocation account balance summary for the Broken basin

Water entitlement	Opening carryover (ML)	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)	Carryover carried forward (ML)
Broken system - Goulburn-Murray Water						
Water shares	3,619	17,342	(4,361)	2,928	6,504	7,169
Tungamah, Devenish and St. James (1)	64	68	0	0	68	64
Loss provision (2)	-	-	-	6,526	-	-
Diversion: Broken system - Goulburn-Murray Water (3)				**9,454**		
Loombah-McCall Say (Benalla)	-	2,324	0	1,494	830	-
Take and use licences - unregulated surface water	-	2,895	0	514	2,381	-
Total 2016–17	**3,683**	**22,628**	**(4,361)**	**11,462**	**9,782**	**7,233**
Total 2015–16	4,830	9,718	(638)	11,098	3,503	3,692

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 2016–17, 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 provision of 1850 ML. In 2016–17, GMW reported that during regulated conditions, the losses from Broken Creek were 2960 ML over the loss provision allowed.

(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.

The estimated volume of water harvested from small catchment dams represented the largest diversion of surface water in the Broken basin (Table 6-28). The capacity of small catchment dams for Broken basin is estimated based on GIS mapping. The GIS data used to derive the capacity values for small catchment dams was updated in 2015–16, to provide a more-accurate measure.

Table 6-28 Estimated small catchment dam information for the Broken basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	18,875	9,438	n/a
Registered commercial and irrigation	8,724	7,328	n/a
Total	**27,599**	**16,766**	**25,391**

n/a Information not available.

6.5.3 Recycled water

North East Water operates the wastewater treatment plants in the Broken basin at Benalla and the new plant in Tungamah. As with the previous three years, 100% of the wastewater produced in 2016–17 was recycled.

Table 6-29 shows the volumes and uses of recycled water in the Broken basin in 2016–17. Where water has been recycled within the plant process, this volume has not been included in the percent recycled value.

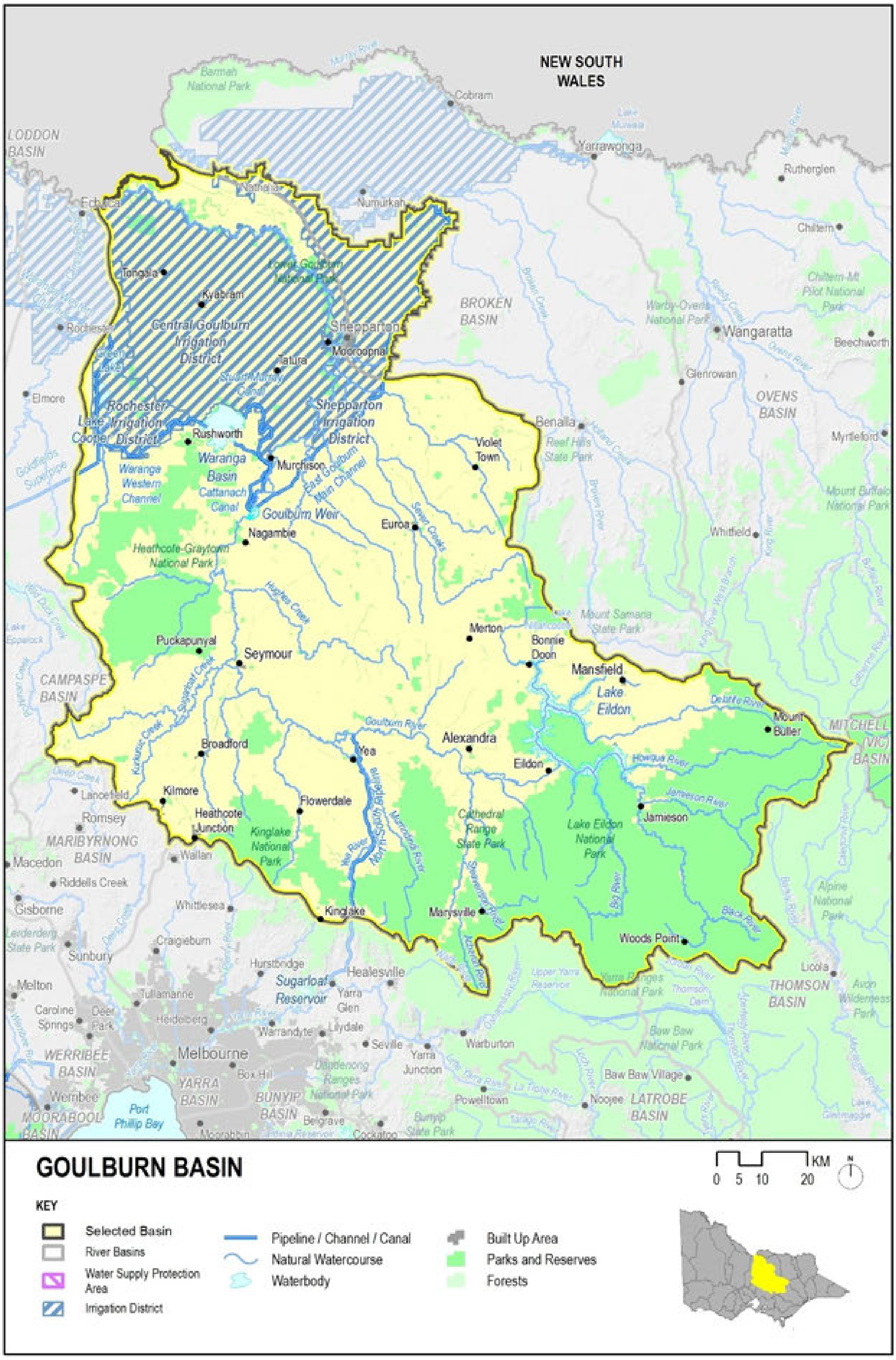
Table 6-29 Volume and use of recycled water in the Broken basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled (excludes within plant process)	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	439	439	100%	0	439	0	0	0	0
Tungamah	6	6	100%	0	6	0	0	0	0
Total 2016–17	**445**	**445**	**100%**	**0**	**445**	**0**	**0**	**0**	**0**
Total 2015–16	436	436	100%	0	436	0	0	0	0

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 Water resources overview

In 2016–17, rainfall across the Goulburn basin ranged between 80% and 150% of the long-term average. While most of the basin received between 100% and 125% of the long-term average rainfall, a portion to the south received between 80% and 100%, whilst a small section to the north-west received between 125% and 150%.

Catchment inflows were 94% of the long-term average, compared to 31% in 2015–16. The amount of water flowing from the Goulburn basin into the Murray River represented 48% of the total inflows into the basin.

The volume of water in major storages in the Goulburn basin started the year at 38% of capacity and ended the year at 63% of capacity.

The opening seasonal allocation for high-reliability water shares was announced on 1 July 2016 at 8% and reached 100% in by mid-October 2016. There was no seasonal allocation for low-reliability water shares in 2016–17.

In the Goulburn basin, there were no restrictions on unregulated streams until December 2016, when a licensed diversion ban was placed on the Sunday Creek. Licensed diversion bans came into effect on the Wallaby and Sevens creeks in February, and only Sunday Creek remained on restrictions for the remainder of the year, with the ban on Sevens Creek lifted in April 2017. The Yea River and its tributaries (including Murrundindi Creek) had a stage 3 roster in place from March to June. The total number of streams on restrictions peaked in March 2017 to four, unlike the previous year where eight streams were restricted by April 2016.

No urban water use restrictions applied in the Goulburn basin in 2016–17 with all towns remaining on permanent water savings rules throughout the year.

Table 6-30 shows the responsibilities of the authorities within the Goulburn basin.

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

Authority	Irrigation and rural water supply	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
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 Obliged to meet passing flow requirements
Goulburn Valley Water			Supplies towns located in the Goulburn basin including Shepparton, Alexandra and Seymour	Obliged to meet passing flow requirements
Coliban Water			Can supply towns located in the Loddon and Campaspe basins from the Goulburn basin including Bendigo	Obliged to meet passing flow requirements
Melbourne Water			Operates the Silver–Wallaby diversion system to Melbourne	Obliged to meet passing flow requirements
Grampians Wimmera Mallee Water			Supplies Quambatook	Obliged to meet passing flow requirements
Victorian Environmental Water Holder				Holds and manages entitlements for the environment in the basin
Goulburn Broken Catchment Management Authority				Manages waterways in the region comprising the catchments of the Goulburn and Broken rivers and part of the Murray River valley

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 feeds into the Murray basin, 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 2016–17, water for the environment in the Goulburn basin 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 34,428 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
- 292,289 ML of high-reliability water shares and 47,287 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 240,283 ML of environmental water was delivered in-stream in the Goulburn basin in 2016–17.

6.6.2 Surface water resources

6.6.2.1 Water balance

The total volumes of water available and supplied from water resources in the Goulburn basin in 2016–17 are shown in Table 6-31.

Table 6-31 Balance of surface water in the Goulburn basin

Water account component	2016–17 (ML)	2015–16 (ML)
Major on-stream storage		
Volume in storage at start of year	1,204,968	1,879,721
Volume in storage at end of year	2,141,867	1,204,968
Change in storage	**936,899**	**(674,753)**
Inflows		
Catchment inflow (1)	3,170,630	1,045,733
Rainfall on major storages	86,181	58,894
Inflow from Broken River at Gowangardie	374,310	38,514
Inflow from Loddon via the Goulburn supplement	22,747	0
Return flow from irrigation	0	0
Transfer from Campaspe via Waranga Western Channel	0	0
Treated wastewater discharged back to river	2,294	976
Total inflows	**3,656,161**	**1,144,117**
Outflows		
Diversions		
Urban diversions	24,772	28,783
Irrigation district diversions	664,576	1,025,556
Licensed diversions from regulated streams	12,766	18,859
Licensed diversions from unregulated streams	12,790	10,496
Transfer from Silver and Wallaby creeks to Yarra basin	3,058	1,059
Transfers to Melbourne via North-South Pipeline (2)	0	0
Environmental water diversions	0	2,371
Small catchment dams	47,106	47,106
Total diversions	***765,069***	***1,134,230***
Losses		
Evaporation losses from major storages	94,669	83,831
Losses from small catchment dams	17,243	17,243
In-stream infiltration to groundwater, flows to floodplain and evaporation	93,438	112,406
Total losses	***205,350***	***213,480***
Water passed at outlet of basin		
Goulburn River to Campaspe River via Waranga Western Channel	55	450
Goulburn River outflow to Murray River	1,741,785	440,438
Goulburn River outflow to Murray River via Broken Creek	7,004	30,271
Total water passed at outlet of basin	***1,748,844***	***471,160***
Total outflows	**2,719,262**	**1,818,870**

Notes

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

(2) 17.5 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 fire-fighting purposes.

6.6.2.2 Storages and flows

The total volume for all major storages in the basin was 2,391,636 ML at the end June 2017 (or 63% of the total storage capacity), compared to 1,449,598 ML at the start of July 2016 (Table 6-32). The volume reported in the 'Catchment inflows less regulated releases' column in Table 6-32 is the balancing item for each storage. It represents the flows of water in or out of the storage that are not shown as rainfall or evaporation, and may include other minor components influencing the change in storage during the year.

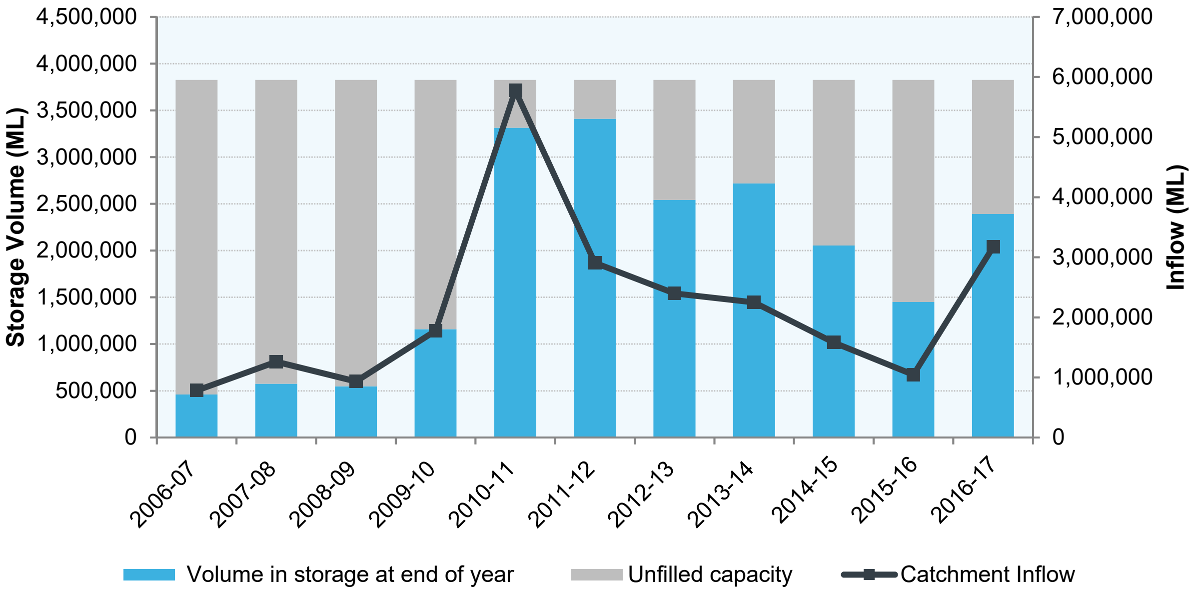
Only volumes for major on-stream storages have been included in the water balance in Table 6-32. Major off-stream storages (such as Waranga basin and Greens Lake) have not been included.

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	20,134	7,385	10,524	7,128	24,123
Lake Eildon	3,334,158	1,184,195	78,674	83,997	937,906	2,116,778
Sunday Creek Reservoir	1,650	639	122	148	353	966
Total on-stream storages	**3,361,308**	**1,204,968**	**86,181**	**94,669**	**945,387**	**2,141,867**
Off-stream storages						
Greens Lake	32,500	17,862	2,839	5,062	6,960	22,599
Waranga basin	432,360	226,768	33,003	63,356	30,755	227,170
Total off-stream storages	**464,860**	**244,630**	**35,842**	**68,418**	**37,715**	**249,769**
Total storage volumes	**3,826,168**	**1,449,598**	**122,023**	**163,087**	**983,102**	**2,391,636**

Catchment inflows to the Goulburn basin in 2016–17 were 94% (3,170,647 ML) of the long-term average (Figure 6-11), more than triple the volume received in 2015–16 (1,045,733 ML). The amount of water flowing from the Goulburn basin into the Murray River increased to 1,748,789 ML in 2016–17. This represented 48% of the total inflows into the Goulburn basin, an increase from 41% in 2015–16.

Figure 6-11 Storage volumes and catchment inflows in the Goulburn basin



6.6.2.3 Entitlement volumes and diversions

Goulburn-Murray Water, Coliban Water, Goulburn Valley Water, Grampians Wimmera Mallee Water, the Melbourne metropolitan retail water corporations (City West Water, South East Water and Yarra Valley Water), Melbourne Water and AGL Hydro Ltd all hold bulk entitlements in the Goulburn basin. Surface water is also diverted by licensed diverters and is harvested in small catchment dams.

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 in the Goulburn basin include rights granted to individuals (for example, water shares and take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations or the VEWH). Rights to water in the Goulburn basin are outlined in Table 6-33.

Table 6-33 Entitlement volumes in the Goulburn basin

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (Eildon – Goulburn Weir) Conversion Order 1995 (1)	
High-reliability water shares	1,046,227
Low-reliability water shares	456,049
High-reliability supply by agreements	4,490
Low-reliability supply by agreements	1,851
Waterworks districts (2)	2,291
BE (Goulburn Channel System - CW) Order 2012	2,420
BE (Goulburn River – GVW) Order 2012	26,299
BE (Goulburn Channel System – GVW) Order 2012	7,191
Bulk Entitlement (Quambatook – Grampians Wimmera Mallee Water) Order 2006	100
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
Sub-total: Goulburn system – Melbourne metropolitan retailers	**n/a**
Environmental Entitlement (Goulburn System – Living Murray) 2007	196,605
Environmental Entitlement (Goulburn System – NVIRP Stage 1) 2012 (4)	n/a
Bulk Entitlement (Goulburn System – Snowy Environmental Reserve) Order 2004	38,408
Goulburn River Environmental Entitlement 2010	11,991
Loss provision - irrigation district (5)	316,210
Subtotal: Bulk Entitlement (Eildon – Goulburn Weir) Conversion Order 1995	**2,110,131**
Bulk Entitlement (Broadford, Kilmore and Wallan) Conversion and Augmentation Order 2003 (6)	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
Bulk Entitlement (Woods Point) Conversion Order 1995	30
Bulk Entitlement (Yea) Conversion Order 1997	438
Bulk Entitlement (Rubicon – Southern Hydro Ltd) Conversion Order 1997 (7)	0
Bulk Entitlement (Silver and Wallaby Creeks – Melbourne Water) Order 2014 (8)	22,000
Silver and Wallaby Creeks Environmental Entitlement 2006 (9)	n/a
Take and use licences – unregulated surface water	23,965
Total volume of water entitlements in the Goulburn basin	**2,163,895**

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 entitlement includes losses and excludes the volume to supply Grampians Wimmera Mallee Water's Quambatook bulk entitlement (100 ML) and Coliban Water (65 ML), as described in Goulburn-Murray Water's Eildon–Goulburn Weir bulk entitlement.

(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.

(4) 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.

(5) This represents the maximum loss provisions outlined in the bulk entitlement. The actual loss allowed will vary year to year, based on the rules in the bulk entitlement, actual delivery volumes, carry over or headroom allowance.

(6) 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).

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

(8) 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.

(9) 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 volume is not required.

n/a Specified volume not applicable.

Allocation available under bulk entitlements and licences for 2016–17 is presented in Table 6-34. 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. 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; there were no spill events in 2016–17 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 for 2016–17 are presented in Table 6-34. Diversions under these 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 MDBA's website > Publications). Before this, details of this assessment were published annually in the MDBA's *Water Audit Monitoring Report.*

Table 6-34 Allocation account balance summary for the Goulburn basin

Water entitlement	Opening carryover (ML)	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)	Carryover carried forward (ML)
Eildon – Goulburn Weir						
Water shares	292,003	1,046,067	(142,828)	530,339	43,932	620,971
Supply by agreements	1,948	4,497	(227)	2,675	414	3,129
Waterworks districts (1)	-	2,305	0	1,127	1,178	-
Goulburn channel system – CW	1,150	2,420	(770)	1,602	71	1,127
Goulburn River and Eildon – GVW (2)	7,598	26,453	(20,022)	14,027	0	2
Goulburn channel system – GVW	1,750	7,191	(3,894)	4,864	9	174
Quambatook – GWMWater	3	100	100	97	10	95
Goulburn system – Melbourne retailers	22,836	20,499	(14,687)	18	1,432	27,199
Environmental Entitlement Goulburn system – Living Murray (3)	15,839	39,625	0	20,000	1,203	34,261
Goulburn System – NVIRP Stage 1 (3)	30,750	21,400	(4,292)	13,430	1,721	32,707
Goulburn system – Snowy Environmental Reserve	1,513	30,252	(31,765)	0	0	0
Goulburn River environmental entitlement (3)	11,255	8,851	189,887	206,853	157	2,983
Operating provisions (whole of system) (3)	-	-	-	49,283	-	-
District loss (4)	-	-	-	93,901	-	-
Diversion: Eildon – Goulburn Weir (5)				**697,933**		
Broadford, Kilmore and Wallan	-	2,238	0	1,990	248	-
Buxton	-	110	0	0	110	-
Euroa system	-	1,990	0	669	1,321	-
Longwood	-	120	0	52	68	-
Mansfield	-	1,300	0	855	445	-
Marysville	-	462	0	254	208	-
Pyalong	-	75	0	35	40	-
Silver and Wallaby creeks – Melbourne Water	-	22,000	0	3,058	18,942	-
Strathbogie	-	23	0	5	18	-
Thornton	-	120	0	0	120	-
Upper Delatite	-	235	0	108	128	-
Violet Town	-	20	0	0	20	-
Woods Point	-	30	0	7	23	-
Yea	-	438	0	208	230	-
Rubicon – Hydro Ltd	-	0	0	0	-	-
Silver and Wallaby Creeks Environmental Entitlement	-	0	0	0	-	-
Take and use licences – unregulated surface water	-	24,226	(27)	12,790	11,463	-
Total 2016–17	**386,644**	**1,263,047**	**(28,524)**	**717,963**	**83,511**	**722,648**
Total 2015–16	296,767	1,157,395	(6,486)	1,082,957	387,281	298,233

Notes

(1) Reported volumes relate to stock and domestic customers 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 154 ML, credited to Goulburn Valley Water for return flows from GMW customers.
(3) The water use reported under these entitlements is in-stream use and is therefore not included in the calculation of total diversion for the Eildon–Goulburn Weir bulk entitlement.
(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 outfalls 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.

The estimated volume of water harvested from small catchment dams in the Goulburn basin is shown in Table 6-35. The capacity of small catchment dams for Goulburn basin is estimated based on GIS mapping. The GIS data used to derive the capacity values for small catchment dams was updated in 2015–16, to provide a more-accurate measure.

Table 6-35 Estimated small catchment dam information for the Goulburn basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	57,724	28,862	n/a
Registered commercial and irrigation	21,719	18,244	n/a
Total	**79,443**	**47,106**	**64,349**

n/a Information not available.

6.6.3 Recycled water

Goulburn Valley Water operates all wastewater treatment plants in the Goulburn basin. In 2016–17, about 71% of the volume of wastewater passing through treatment plants in the basin was recycled, a decrease from 89% in 2015–16. In addition to the recycled water reported below, 149 ML was returned from the Mount Buller Resort to Black Dog Creek and other waterways during the water year.

Table 6-36 shows the volumes and uses of recycled water in the Goulburn basin in 2016–17. Where water has been recycled within the plant process, this volume has not been included in the percent recycled value.

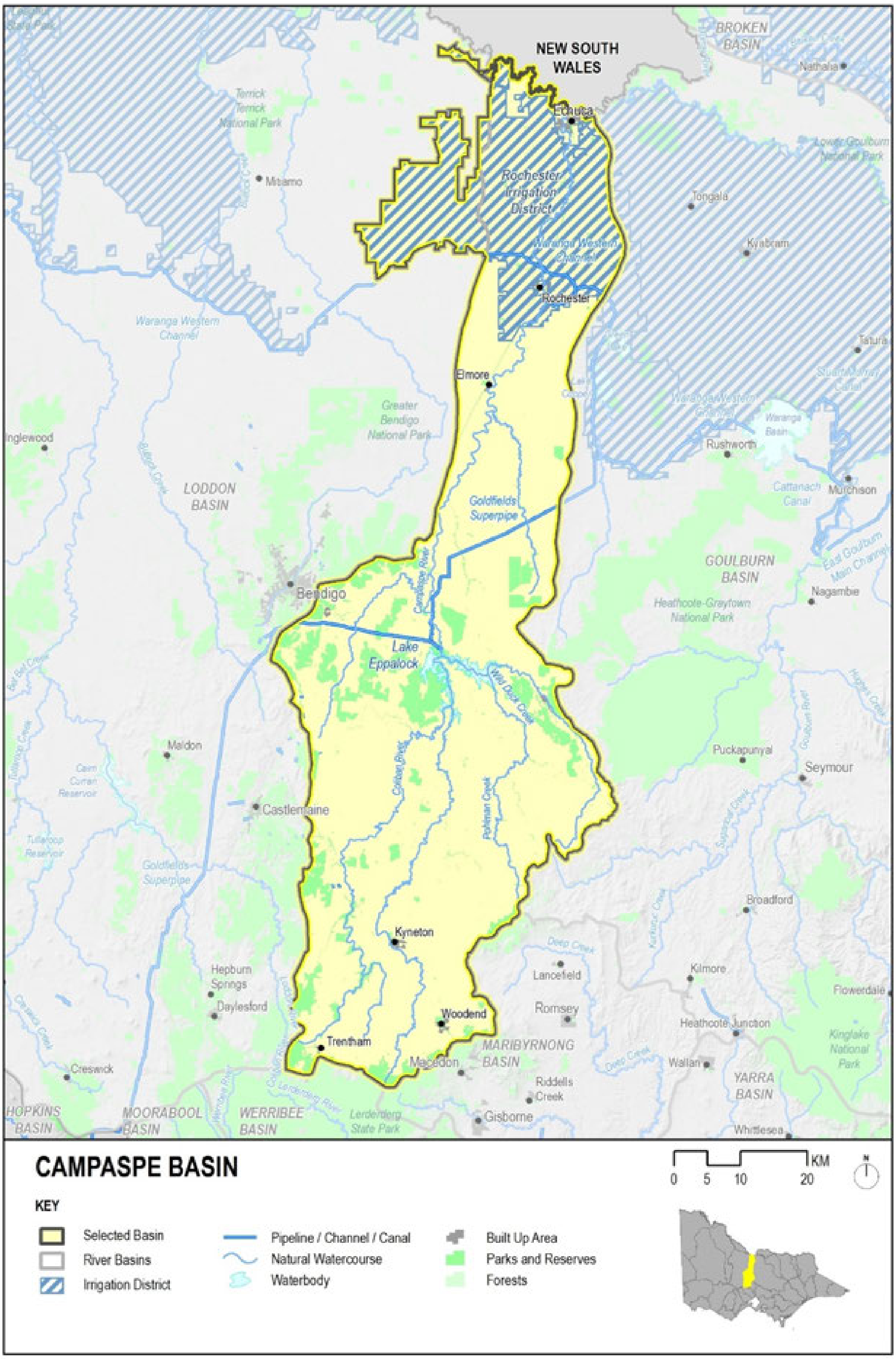
Table 6-36 Volume and use of recycled water in the Goulburn basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled (excludes within plant process)	Type of end use (ML)				Volume discharged to the environment	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Alexandra	214	120	56%	90	30	0	0	95	0
Avenel	54	28	51%	0	28	0	0	26	0
Bonnie Doon	29	29	100%	0	29	0	0	0	0
Broadford	197	109	55%	0	109	0	0	88	0
Eildon	137	83	60%	83	0	0	0	54	0
Euroa	239	165	69%	50	114	0	0	74	0
Girgarre	0	0	0%	0	0	0	0	0	0
Kilmore	327	225	69%	0	225	0	0	102	0
Kyabram / Merrigum	232	232	100%	0	232	0	0	0	0
Mansfield	450	306	68%	54	252	0	0	144	0
Marysville	57	57	100%	55	2	0	0	0	0
Mooroopna	826	826	100%	0	826	0	0	0	0
Murchison	0	0	0%	0	0	0	0	0	0
Nagambie	99	70	71%	0	70	0	0	29	0
Seymour	461	311	67%	63	247	0	0	150	0
Shepparton	2,886	1,720	60%	0	1,720	0	0	1,167	0
Stanhope / Rushworth	2	2	100%	0	2	0	0	0	0
Tatura	736	551	75%	0	551	0	0	185	0
Tongala	156	156	100%	0	156	0	0	0	0
Upper Delatite	50	50	100%	0	50	0	0	0	0
Violet Town	28	28	100%	0	28	0	0	0	0
Yea	128	98	76%	41	57	0	0	30	0
Total 2016–17	**7,308**	**5,166**	**71%**	**436**	**4,728**	**0**	**0**	**2,144**	**0**
Total 2015–16	7,737	6,893	89%	589	6,305	0	0	844	0

6.7 Campaspe basin

The Campaspe basin (Figure 6-12) 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 6-12 Map of the Campaspe basin



6.7.1 Water resources overview

In 2016–17, rainfall in the Campaspe basin north of Lake Eppalock was mostly between 125% and 150% of the long-term average, with all other parts of the basin receiving between 100% and 125% of the long-term average.

Catchment inflows to the Campaspe basin were 127% of the long-term average, compared to 16% in 2015–16.

The volume of water in major storages in the Campaspe basin was 26% of capacity at the start of the year and 87% at the end of June 2017.

The first seasonal allocation for high-reliability water shares was announced on 1 August 2016 at 21%. However, good rainfall and streamflows saw both high and low-reliability water shares reach 100% by mid-September 2017.

In the Campaspe basin, seven unregulated streams began the year with licensed diversion bans in place. These were lifted at the end of July 2016, with all streams remaining unrestricted until November when bans were put in place on the Wanalta and Cornella creeks. The number of streams restricted increased each month up until April 2017, when a peak of 19 streams had bans in place. Bans were lifted in three of these streams — the Coliban River, Jones Creek and Wild Duck Creek — by May, with 16 streams remaining restricted up until 30 June 2017. No urban water use restrictions were applied in the Campaspe basin in 2016–17, with all towns remaining on permanent water-saving rules throughout the year.

Table 6-37 shows the responsibilities of the authorities within the Campaspe basin.

Table 6-37 Responsibilities for water resources management in the Campaspe basin

Authority	Irrigation and rural water supply	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Goulburn–Murray Water	Supplies Rochester Irrigation District and Campaspe area	Manages licensed diversions	Provides bulk water supply to Coliban Water	Operates Lake Eppalock Obliged to meet passing flow requirements
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 Obliged to meet passing flow requirements
Western Water			Supplies urban water for Woodend at the southern end of the basin	Obliged to meet passing flow requirements
Victorian Environmental Water Holder				Holds and manages entitlements for the environment in the basin
North Central Catchment Management Authority				Manages waterways in the whole of the Campaspe basin

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 2016–17, 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 2016–17, a total of 5,551 ML of environmental water was delivered in-stream in the Campaspe basin.

6.7.2 Surface water resources

6.7.2.1 Water balance

The total volumes of water available and supplied from water resources in the Campaspe basin in 2016–17 are shown in Table 6-38.

Table 6-38 Balance of surface water in the Campaspe basin

Water account component	2016–17 (ML)	2015–16 (ML)
Major on-stream storage		
Volume in storage at start of year (1)	99,005	182,150
Volume in storage at end of year (1)	328,640	99,005
Change in storage	**229,635**	**(83,145)**
Inflows		
Catchment inflow (2)	445,441	55,051
Rainfall on major storages	36,546	7,788
Transfer from Waranga Western Channel to Lake Eppalock	55	450
Transfer to Campaspe basin from Waranga Western Channel	0	0
Treated wastewater discharged back to river	1,124	385
Total inflows	**483,166**	**63,673**
Outflows		
Diversions		
Urban diversions	18,197	25,982
Diversion for Coliban Water rural entitlements	5,976	10,222
Licensed diversions from regulated streams	7,515	8,416
Licensed diversions from unregulated streams	690	707
Small catchment dams	22,032	22,032
Transfer from Campaspe basin to Western Waranga Channel	0	0
Transfer from Campaspe basin to White Swan Reservoir	1,359	7,329
Total diversions	***55,768***	***74,688***
Losses		
Evaporation losses from major storages	24,748	24,536
Evaporation from small catchment dams	14,794	14,794
In-stream infiltration to groundwater, flows to floodplain and evaporation	4,421	6,092
Total losses	***43,963***	***45,422***
Water passed at outlet of basin		
Campaspe River outflows to Murray River	153,801	26,416
Total water passed at outlet of basin	***153,801***	***26,416***
Total outflows	**253,532**	**146,526**

Notes

(1) The volume in storage at the start of the year and the volume in storage at the end of the year were incorrectly published in the *Victorian Water Accounts 2015–16* as 179,801 and 96,364 ML respectively.

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

6.7.2.2 Storages and flows

Levels for all major storages in the basin started the year at 99,005 ML (26% of capacity), and after above-average rainfall ended the year 328,640 ML (87% of capacity) in June 2017 (Table 6-39). In the Campaspe basin, major on-stream storages include Lake Eppalock and the Lauriston, Malmsbury and Upper Coliban reservoirs. The volume reported in the 'Catchment inflows less regulated releases' column in Table 6-39 is the balancing item for each storage. It represents the flows of water in or out of the storage that are not shown as rainfall or evaporation and may include other minor components influencing the change in storage during the year.

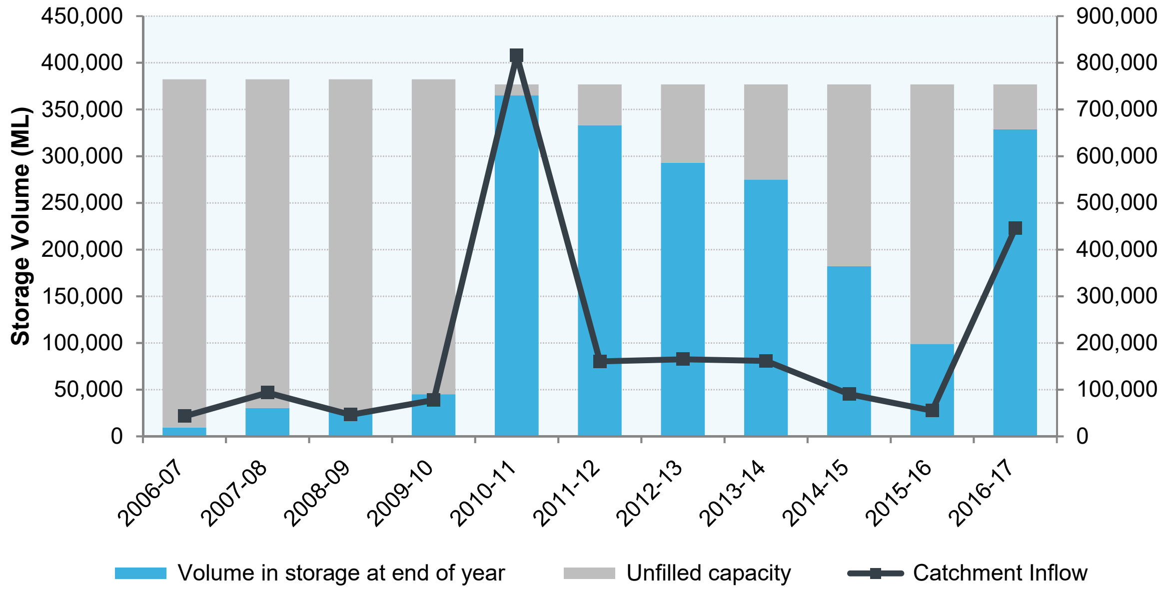
Table 6-39 Storage volumes in the Campaspe basin

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						
Lake Eppalock	304,651	65,662	33,806	17,099	189,110	271,479
Lauriston Reservoir	19,790	13,060	949	1,971	5,213	17,250
Malmsbury Reservoir	12,034	2,745	898	1,858	157	1,942
Upper Coliban Reservoir	37,770	14,897	894	3,820	23,292	35,263
Campaspe Weir	2,624	2,641	n/a	n/a	65	2,706
Total storage volumes	**376,869**	**99,005**	**36,546**	**24,748**	**217,837**	**328,640**

n/a Information not available.

Catchment inflows to the Campaspe basin amounted to 445,441 ML in 2016–17, which was 127%of the long-term average of 352,000 ML (Figure 6-13). The amount of water flowing from the Campaspe basin into the Murray River in 2016–17 was 153,801 ML, representing 32% of the total inflows to the basin.

Figure 6-13 Storage volumes and catchment inflows in the Campaspe basin



6.7.2.3 Entitlement volumes and diversions

Goulburn–Murray Water, Coliban Water and Western Water hold bulk entitlements in the Campaspe basin. Surface water is also diverted by licensed diverters and harvested in small catchment dams.

Entitlements include rights granted to individuals (for example, water shares and take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations or the VEWH). Rights to water in the Campaspe basin are outlined in Table 6-40.

Table 6-40 Entitlement volumes in the Campaspe basin

Water entitlements	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	5,174
Campaspe River Environmental Entitlement 2013	23,618
Operating provisions (whole of system) (3)	11,809
Subtotal: Bulk Entitlement (Campaspe System – Goulburn Murray Water) Conversion Order 2000	**83,590**
Bulk Entitlement (Campaspe System – Coliban Water) Conversion Order 1999 (4)	
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 (5)	120
Bulk Entitlement (Woodend) Conversion Order 2004	470
Take and use licences – unregulated surface water	3,134
Total volume of water entitlements in the Campaspe basin	**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) This volume includes an allowance for volume supplied to the Goulburn system via the Campaspe supplement.

(4) 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.

(5) Coliban Water can take, under the Trentham bulk entitlement, an average of 120 ML per year over a three-year period.

Allocation available under bulk entitlements and licences for 2016–17 is presented in Table 6-41. 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; 21,341 ML was written-off due to spill events in 2016–17.

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 MDBA's website > Publications). Before this, details of this assessment were published annually in the MDBA's *Water Audit Monitoring Report.*

The VEWH holds an environmental entitlement for the Campaspe River. All water available under the entitlement is used to support streamflows and is not diverted out of the waterway. It has therefore not been included as part of the water balance diversions in Table 6-38.

Table 6-41 Allocation account balance summary for the Campaspe basin

Water entitlement	Opening carryover (ML)	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	Write off due to Spill (ML)	End of season forfeitures (ML)	Carryover carried forward (ML)
Campaspe system – Goulburn Murray Water							
Water shares	9,723	42,640	(19,155)	7,515	9,753	855	15,086
Axedale, Goornong and Rochester	324	349	(230)	58	324	3	58
Campaspe River – Living Murray Initiative	20	5,174	0	0	0	20	5,174
Campaspe River Environmental Entitlement 2013 (1)	11,264	23,618	(10,224)	5,551	11,264	3,257	4,586
Operating provisions (whole of system) (2)	-	-	-	0	-	-	-
Net diversion: Campaspe system – Goulburn Murray Water				**7,573**			
Campaspe system – Coliban Water							
Rural entitlements	-	15,741	0	3,373	-	12,368	-
Urban commitments	-	34,518	0	13,705	-	20,813	-
Operating provisions (whole of system)	-	-	-	6,692	-	-	-
Diversion: Campaspe system – Coliban Water				**23,770**			
Trentham	-	120	0	111	-	9	-
Woodend	-	470	0	234	-	236	-
Take and use licences – unregulated surface water (GMW)	-	3,139	0	690	-	2,449	-
Total 2016–17	**21,332**	**125,768**	**(29,609)**	**32,378**	**21,341**	**40,010**	**24,904**
Total 2015–16	13,262	84,026	16,985	42,530	0	41,990	21,361

Notes

(1) The water use reported under these two entitlements is in-stream use and is therefore not included in the calculation of total net diversion for the Bulk Entitlement (Campaspe system – Goulburn–Murray Water) Conversion Order 2000.

(2) The 'water use' 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 2016–17 no supplement was provided to the Goulburn system.

The estimated volume of water harvested from small catchment dams represents the largest diversion of surface water in the Campaspe basin (Table 6-42). The capacity of small catchment dams for Campaspe basin is estimated based on GIS mapping. The GIS data used to derive the capacity values for small catchment dams was updated in 2015–16, to provide a more-accurate measure.

Table 6-42 Estimated small catchment dam information for the Campaspe basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	32,076	16,038	n/a
Registered commercial and irrigation	7,136	5,994	n/a
Total	**39,212**	**22,032**	**42,349**

n/a Information not available.

6.7.3 Recycled water

Coliban Water operates all wastewater treatment plants in the Campaspe basin except the Woodend Treatment Plant, which is operated by Western Water. About 52% of the wastewater discharged from treatment plants in the basin was recycled in 2016–17, a large decrease on 82% from the previous year.

Table 6-43 shows the volumes and uses of recycled water in the Campaspe basin in 2016–17. Where water has been recycled within the plant process, this volume has not been included in the percent recycled value.

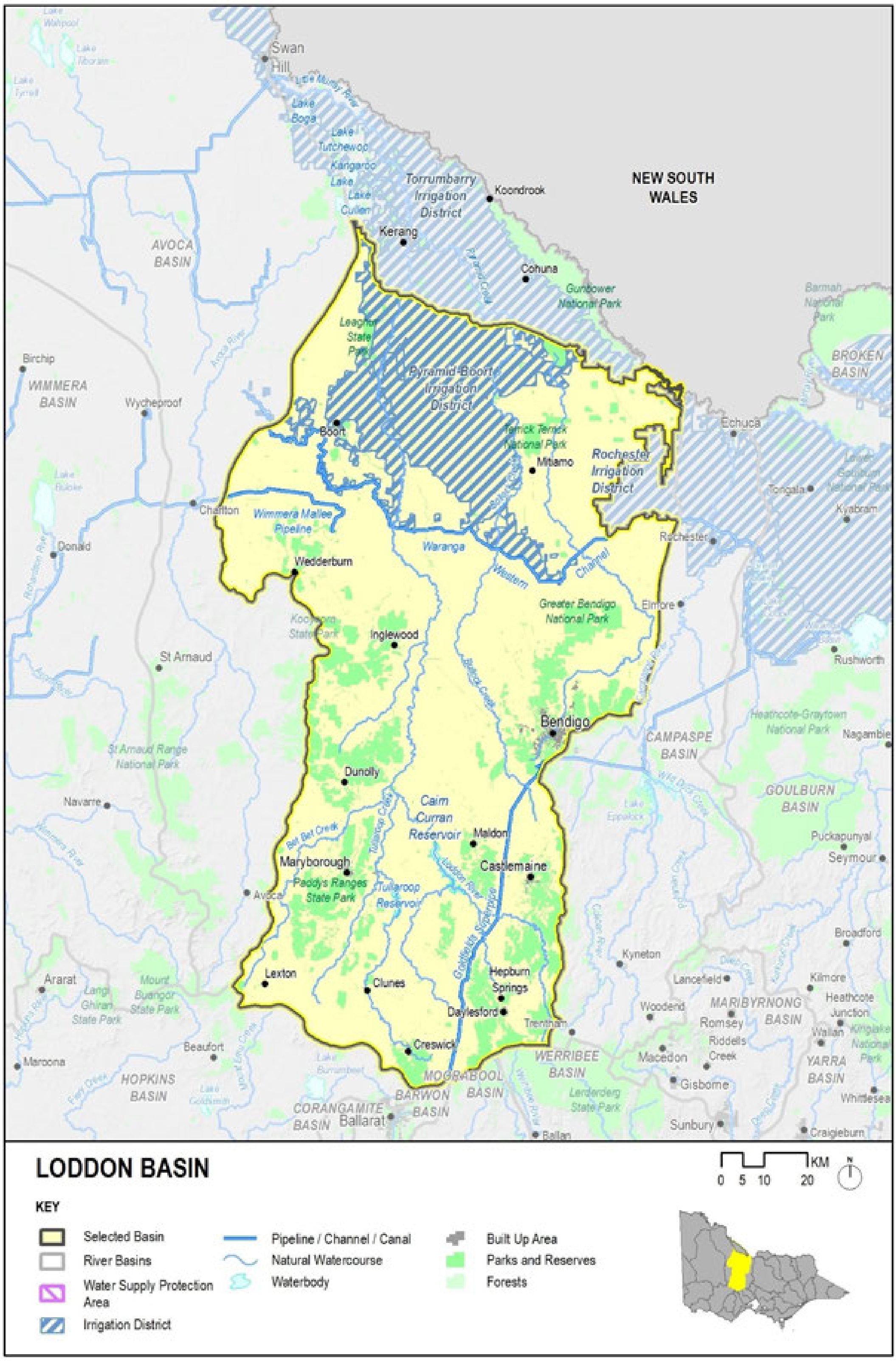
Table 6-43 Volume and use of recycled water in the Campaspe basin

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	9	9	100%	9	0	0	0	0	0
Echuca	846	846	100%	0	846	0	0	0	0
Elmore	0	0	0%	0	0	0	0	0	0
Heathcote	90	90	100%	90	0	0	0	0	0
Kyneton	975	227	23%	61	166	0	0	748	0
Lockington	0	0	0%	0	0	0	0	0	0
Rochester	0	0	0%	0	0	0	0	0	0
Woodend	438	62	14%	34	27	0	1	376	0
Total 2016–17	**2,358**	**1,234**	**52%**	**194**	**1,039**	**0**	**1**	**1,124**	**0**
Total 2015–16	2,159	1,774	82%	314	1,459	0	1	385	0

6.8 Loddon basin

The Loddon basin (Figure 6-14) is located in northern Victoria and includes the Loddon River, Bullarook River and other small tributaries (such as 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 Pyramid Hill–Boort Irrigation District). For the purposes of the water accounts, the Loddon basin excludes the Torrumbarry Irrigation Area, which is mostly supplied from the Murray River.

Figure 6-14 Map of the Loddon basin



6.8.1 Water resources overview

In 2016–17, rainfall in the northern half of the basin was mostly between 125% to 150% of the long-term average, with the remainder of the basin and a small pocket at the northernmost tip receiving between 100% and 125% of the long-term average. The catchment inflow volume was 154% of the long-term average of 373,000 ML, much higher than the previous year of only 21%.

The volume of water in major storages in the Loddon basin was 17% of capacity at the start of the year, and after the above-average rainfall was received storages were 73% full by the end of June 2017.

After several dry years in a row, 2016–17 allocations for high-reliability water shares were announced on 1 August 2016 at 10% allocation in the Loddon system. This increased to 100% in mid-October 2016 after above-average rainfall. No allocations were made to low-reliability water shares during the year. Unlike the previous year, the Bullarook system received an initial allocation of 16% for high-reliability water shares which reached 100% by 15 August 2016. Low-reliability water shares also reached 100% on 15 August 2016.

In contrast to 13 streams on restrictions for the entire year in 2015–16, above-average rainfall in the first half of 2016–17 meant that there were no bans on licensed diversions from unregulated streams in the Loddon basin from August to November 2016. However, bans were in place again in 2016–17 for the majority of streams in the Loddon basin during summer, with 18 restricted from December and a peak of 26 in March 2017. All but four of these bans continued into autumn.

No urban water use restrictions applied in the Loddon basin in 2016–17, with all towns remaining on permanent water-saving rules throughout the year.

Table 6-44 shows the responsibilities of the authorities within the Loddon basin.

Table 6-44 Responsibilities for water resources management in the Loddon basin

Authority	Irrigation and rural water supply	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Goulburn–Murray Water	Supplies the Pyramid–Boort Irrigation Area and domestic and stock supplies in Normanville area 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	Obliged to meet passing flow requirements
Coliban Water			Supplies towns in the eastern and northern parts of the Loddon basin including Bendigo, Castlemaine, Wedderburn, Mitiamo, Pyramid Hill and Boort	Obliged to meet passing flow requirements
Victorian Environmental Water Holder				Holds and manages entitlements for the environment in the basin
North Central Catchment Management Authority				Manages waterways for the whole of the Loddon basin

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 2016–17, water for the environment in the Loddon basin comprised:

- the *Bulk Entitlement (Loddon River – Environmental Water Reserve) Order 2005*, of 3,480 ML high-reliability, 2,024 ML of low-reliability and 7,490 ML of provisional-reliability entitlements 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.

In 2016–17, a total of 12,432 ML of environmental water was delivered in-stream in the Loddon basin.

6.8.2 Surface water resources

6.8.2.1 Water balance

The total volumes of water available and supplied from water resources in the Loddon basin in 2016–17 are shown in Table 6-45.

Table 6-45 Balance of surface water in the Loddon basin

Water account component	2016–17 (ML)	2015–16 (ML)
Major on-stream storage		
Volume in storage at start of year	35,319	84,106
Volume in storage at end of year	170,572	35,319
Change in storage	**135,253**	**(48,787)**
Inflows		
Catchment inflow (1)	575,122	79,109
Rainfall on major storages	16,944	4,799
Treated wastewater discharged back to river	6,405	4,943
Total inflows	**598,471**	**88,851**
Outflows		
Diversions		
Urban diversions	3,706	4,330
Licensed diversions and irrigation diversions from regulated streams	11,194	10,806
Transfer to Goulburn basin (through Loddon supplement)	22,747	0
Licensed diversions from unregulated streams	5,775	5,036
Environmental water diversions	0	660
Small catchment dams	39,361	39,361
Total diversions	***82,783***	***60,193***
Losses		
Evaporation losses from major storages	34,507	16,982
Evaporation from small catchment dams	33,918	33,918
In-stream infiltration to groundwater, flows to floodplain and evaporation	19,302	3,853
Total losses	***87,727***	***54,753***
Water passed at outlet of basin		
Loddon River outflow to Murray River (Appin South)	214,327	20,472
Wandella Creek at Fairley	5,905	0
Mount Hope Creek at Mitiamo	35,725	2,189
Bullock Creek, Calivil Creek and Nine Mile Creek	36,751	31
Total water passed at outlet of basin	***292,707***	***22,692***
Total outflows	**463,218**	**137,638**

Note

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

6.8.2.2 Storages and flows

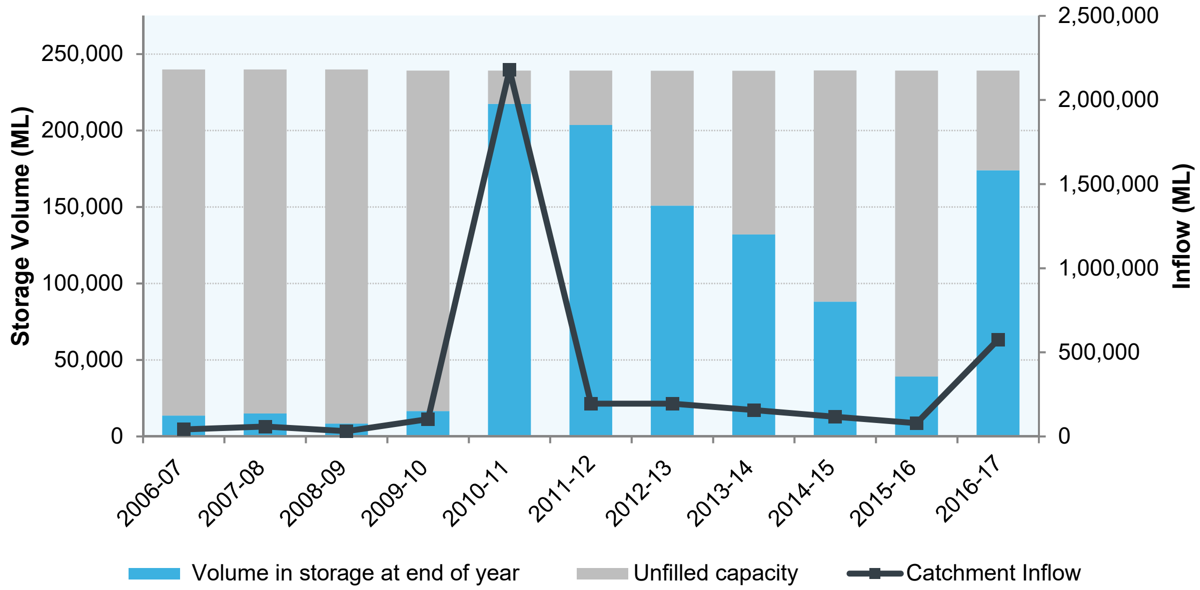
The volume of water held in major storages was 173,987 ML (73% of capacity) at the end of June 2017, compared to 40,106 ML (17% of capacity) at the beginning of the year (Table 6-46). The volume reported in the 'Catchment inflows less regulated releases' column is the balancing item for each storage. It represents the flows of water in or out of the storage that are not shown as rainfall or evaporation, and may include other minor components influencing the change in storage during the year. Cairn Curran Reservoir, which comprises nearly two-thirds of the storage capacity in the basin, finished the year with 110,233 ML in storage (75% of capacity).

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	17,234	8,128	18,138	103,009	110,233
Hepburn Lagoon	2,457	446	2,776	5,385	3,761	1,598
Laanecoorie Reservoir	8,000	1,660	1,712	2,936	2,754	3,190
Newlyn Reservoir	3,012	526	361	691	1,867	2,063
Tullaroop Reservoir	72,950	15,453	3,967	7,357	41,425	53,488
Total on-stream storages	**233,549**	**35,319**	**16,944**	**34,507**	**152,816**	**170,572**
Off-stream storages						
Evansford Reservoir	1,346	921	151	242	166	996
Sandhurst Reservoir	2,590	2,595	191	254	(1,157)	1,375
Spring Gully Reservoir	1,680	1,271	428	267	(388)	1,044
Total off-stream storages	**5,616**	**4,787**	**770**	**763**	**(1,379)**	**3,415**
Total storage volumes	**239,165**	**40,106**	**17,714**	**35,270**	**151,437**	**173,987**

Catchment inflows were 154% (575,122 ML) of the long-term average of 373,000 ML, a large increase compared to the volume of inflows received in 2015–16 (79,109 ML) (Figure 6-15). The amount of water flowing from the Loddon basin was 292,707 ML in 2016–17. This represents 49% of the total Loddon basin inflows, compared to 26% in 2015–16.

Figure 6-15 Storage volumes and catchment inflows in the Loddon basin



6.8.2.3 Entitlement volumes and diversions

In the Loddon basin, surface water is diverted by Goulburn–Murray Water, Central Highlands Water, Coliban Water and the VEWH which all hold bulk entitlements in the basin. Surface water is also diverted by licensed diverters and harvested in small catchment dams.

Entitlements in the Loddon basin include rights granted to individuals (for example, water shares and take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations or the VEWH). Rights to water in the Loddon basin are outlined in Table 6-47.

Table 6-47 Entitlement volumes in the Loddon basin

Water entitlements	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	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 (2)	88,000
Sub-total: Bulk Entitlement (Loddon System - Goulburn-Murray Water) Conversion Order 2005	**132,484**
Bulk Entitlement (Bullarook system - Goulburn-Murray Water) Conversion Order 2009 (3)	
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
Sub-total: Bulk Entitlement (Bullarook system - Goulburn-Murray Water) Conversion Order 2009	**1,739**
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	22,186
Total volume of water entitlements in the Loddon basin	**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) 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.

(3) 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.

Allocation available under bulk entitlements and licences for 2016–17 is presented in Table 6-48. 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 (end-of-season forfeiture).

Diversions under these 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 MDBA's website > Publications). Before this, details of this assessment were published annually in the MDBA's *Water Audit Monitoring Report.*

Table 6-48 Allocation account balance summary for the Loddon basin

Water entitlement	Opening carryover (ML)	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)	Carryover carried forward (ML)
Loddon System - Goulburn-Murray Water						
Water shares - Loddon	5,551	16,810	(10,286)	4,891	1,785	5,399
Loddon River - Environmental Reserve (1)	2,703	12,791	1,678	12,432	2,037	2,703
Loddon System - Part Maryborough - Central Highlands Water	900	1,200	(450)	758	0	892
Loddon System - Coliban Water	390	431	(200)	340	14	266
Goulburn supplement (2)	-	-	-	22,747	-	-
Operating provisions (whole of system) (3)	-	-	-	5,735	-	-
Diversion: Loddon system - Goulburn-Murray Water (4)				**34,472**		
Bullarook System - Goulburn-Murray Water						
Water shares - Bullarook	107	1,031	0	567	222	349
Bullarook System - Central Highlands Water	103	397	0	121	142	238
Environmental Entitlement Birch Creek – Bullarook System (5)	0	100	0	0	0	100
Diversion: Bullarook system - Goulburn-Murray Water (6)				**688**		
Creswick	-	500	0	500	0	-
Daylesford - Hepburn Springs	-	916	0	572	344	-
Lexton	-	45	0	0	45	-
Evansford-Talbot System-Part Maryborough-Central Highlands Water	-	3,000	0	1,415	1,585	-
Take and use licences - unregulated surface water	-	22,216	19	5,775	16,459	-
Total 2016–17	**9,754**	**59,436**	**(9,239)**	**43,422**	**22,633**	**9,946**
Total 2015–16	6,852	55,616	70,908	61,801	0	0

Notes

(1) The water use reported here is in-stream use and is therefore not included in the calculation of total diversion for the Loddon system –Goulburn-Murray Water bulk entitlement.

(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.
(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 use reported in this line item represents the bulk diversion to supply primary entitlements under the Bullarook system source bulk entitlement.

The estimated volume of water harvested from small catchment dams represents the largest diversion of surface water in the Loddon basin (Table 6-49). The capacity of small catchment dams for Loddon basin is estimated based on GIS mapping. The GIS data used to derive the capacity values for small catchment dams was updated in 2015–16, to provide a more-accurate measure.

Table 6-49 Estimated small catchment dam information for the Loddon basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	48,816	24,408	n/a
Registered commercial and irrigation	17,801	14,953	n/a
Total	**66,617**	**39,361**	**73,279**

n/a Information not available.

6.8.3 Recycled water

Coliban Water, Lower Murray Water and Central Highlands Water operate wastewater treatment plants within the Loddon basin. The percentage of wastewater produced in 2016–17 decreased to 18%, compared to 34% in 2015–16.

Table 6-50 shows the volumes and uses of recycled water in the Loddon basin in 2016–17. Where water has been recycled within the plant process, this volume has not been included in the percent recycled value.

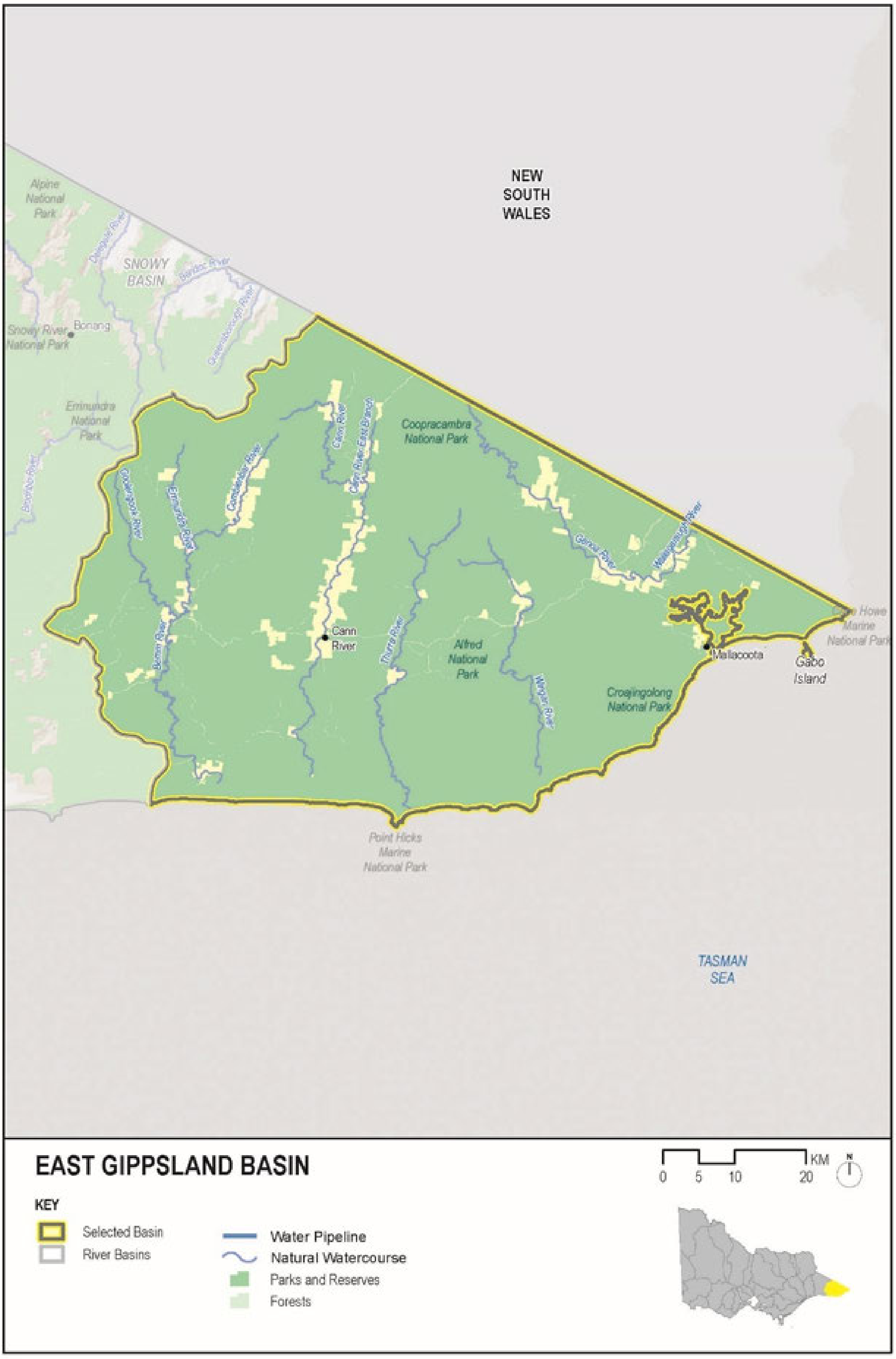
Table 6-50 Volume and use of recycled water in the Loddon basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled (excludes within plant process)	Type of end use (ML)				Volume discharged to the environment	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Bendigo	6,000	1,039	17%	763	276	0	0	4,961	0
Boort	0	0	0%	0	0	0	0	0	0
Bridgewater / Inglewood	0	0	0%	0	0	0	0	0	0
Castlemaine	1,376	39	3%	39	0	0	0	1,336	0
Clunes	47	14	30%	0	14	0	0	33	0
Daylesford	452	376	83%	10	366	0	0	75	0
Dunolly	22	22	100%	0	22	0	0	0	0
Kerang	602	0	0%	0	0	0	0	0	602
Maryborough	581	132	23%	0	132	0	0	0	449
Pyramid Hill	11	11	100%	0	11	0	0	0	0
Waubra	10	5	50%	0	5	0	0	0	5
Wedderburn	34	34	100%	0	34	0	0	0	0
Total 2016–17	**9,135**	**1,672**	**18%**	**812**	**860**	**0**	**0**	**6,405**	**1,056**
Total 2015–16	8,110	2,790	34%	1,460	1,330	0	0	4,943	377

6.9 East Gippsland basin

The East Gippsland basin (Figure 6-16) 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 6-16 Map of the East Gippsland basin



6.9.1 Water resources overview

In 2016–17, rainfall in the East Gippsland basin was between 80% and 100% of the long-term average, with a small area in the east of the basin receiving 60% to 80% of the long-term average.

Catchment inflows were 83% of the long-term annual average of 714,000 ML, a large reduction compared to 163% in 2015–16. Consumptive use in the basin is generally very low compared to water availability, and almost 100% of total inflows passed to Bass Strait in 2016–17.

All unregulated streams remained unrestricted and there were no urban water use restrictions applied in the East Gippsland basin in 2016–17, with all towns remaining on permanent water-saving rules throughout the year.

Table 6-51 shows the responsibilities of the authorities within the East Gippsland basin.

Table 6-51 Responsibilities for water resources management in the East Gippsland basin

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Southern Rural Water	Manages licensed diversions		
East Gippsland Water		Supplies urban water to towns including Mallacoota, Cann River and Bemm River	Obliged to meet passing flow requirements
East Gippsland Catchment Management Authority			Manages waterways for the entire East Gippsland basin

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 2016–17, 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.

6.9.2 Surface water resources

6.9.2.1 Water balance

The total volumes of water available and supplied from water resources in the East Gippsland basin in 2016–17 are shown in Table 6-52. Very low volumes of surface water are used relative to the available resource in the basin. No storage information is recorded in the water balance as there are no major on-stream storages in the East Gippsland basin.

About 1% of the catchment inflows were diverted for consumptive use, predominantly from small catchment dams.

Table 6-52 Balance of surface water in the East Gippsland basin

Water account component	2016–17 (ML)	2015–16 (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)	590,896	1,161,494
Rainfall on major storages	-	-
Treated wastewater discharged back to river	0	0
Total inflows	**590,896**	**1,161,494**
Outflows		
Diversions		
Urban diversions	124	104
Licensed diversions from unregulated streams	95	56
Small catchment dams	711	711
Total diversions	***929***	***871***

Losses		
Evaporation losses from major storages	-	-
Evaporation from small catchment dams	227	227
In-stream infiltration to groundwater, flows to floodplain and evaporation (2)	n/a	n/a
Total losses	***227***	***227***
Water passed at outlet of basin		
River outflows to the ocean	589,741	1,160,397
Total water passed at outlet of basin	***589,741***	***1,160,397***
Total outflows	**590,896**	**1,161,494**

Notes

(1) Catchment inflows is the balancing item in this water balance. It is the difference between the total outflows and the known inflows.

(2) No suitable model is available to make an estimate of in-stream losses.

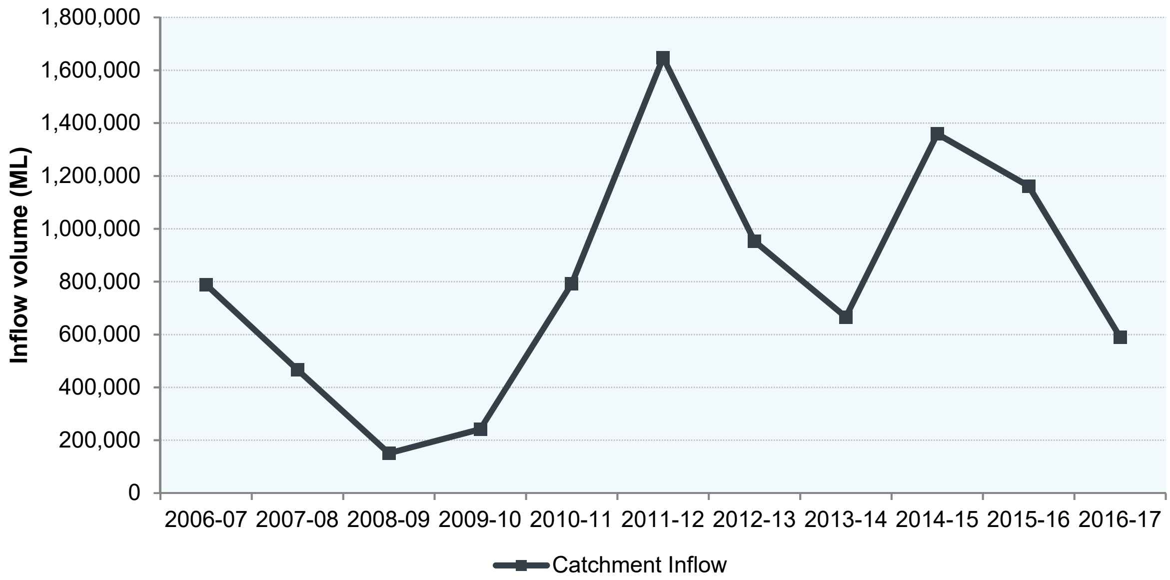
6.9.2.2 Storages and flows

Catchment inflows were 83% (590,896 ML) of the long-term annual average of 714,000 ML, a large decrease from the 163% (1,161,494 ML) recorded in 2015–16 (Figure 6-17).

The amount of water flowing from the East Gippsland basin into Bass Strait was 589,741 ML in 2016–17, compared to 1,160,397 ML in 2015–16. Basin outflows were close to 100% of total inflows into the basin.

There are no major storages located within the East Gippsland basin.

Figure 6-17 Catchment inflows in the East Gippsland basin



6.9.2.3 Entitlement volumes and diversions

In the East Gippsland basin, surface water is diverted by East Gippsland Water and licensed diverters, and water is harvested in small catchment dams.

Entitlements include rights granted to individuals (take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations or the VEWH). Rights to water in the East Gippsland basin are outlined in Table 6-53.

Table 6-53 Entitlement volumes in the East Gippsland basin

Water entitlements	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	659
Total volume of water entitlements in the East Gippsland basin	**1,281**

Allocation available under bulk entitlements and licences for 2016–17 is presented in Table 6-54. The total volume of water diverted by bulk entitlement holders was similar to the volume reported in the *Victorian Water Accounts 2015–16*.

As in previous years, the volume of water diverted from unregulated streams by take and use licence holders in the East Gippsland basin (Table 6-54) remains significantly lower than the total licence volume.

Table 6-54 Allocation account balance summary for the East Gippsland basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Bemm River	100	0	23	77
Cann River	192	0	36	156
Mallacoota	330	0	65	265
Take and use licences - unregulated surface water	659	0	95	564
Total 2016–17	**1,281**	**0**	**219**	**1,062**
Total 2015–16	1,282	0	160	1,122

The estimated volume of water harvested from small catchment dams represents the largest diversion of water in the East Gippsland basin (Table 6-55). The capacity of small catchment dams for East Gippsland basin is estimated based on GIS mapping. The GIS data used to derive the capacity values for small catchment dams was updated in 2015–16, to provide a more-accurate measure.

Table 6-55 Estimated small catchment dam information for the East Gippsland basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	1,126	563	n/a
Registered commercial and irrigation	176	148	n/a
Total	**1,302**	**711**	**937**

n/a Information not available.

6.9.3 Recycled water

East Gippsland Water operates wastewater treatment plants at Bemm River, Cann River and Mallacoota. As with 2015–16, 100% of wastewater was recycled in 2016–17 and used for agricultural applications including pasture and tree plantations.

Table 6-56 shows the volumes and uses of recycled water in the East Gippsland basin in 2016–17. Where water has been recycled within the plant process, this volume has not been included in the percent recycled value.

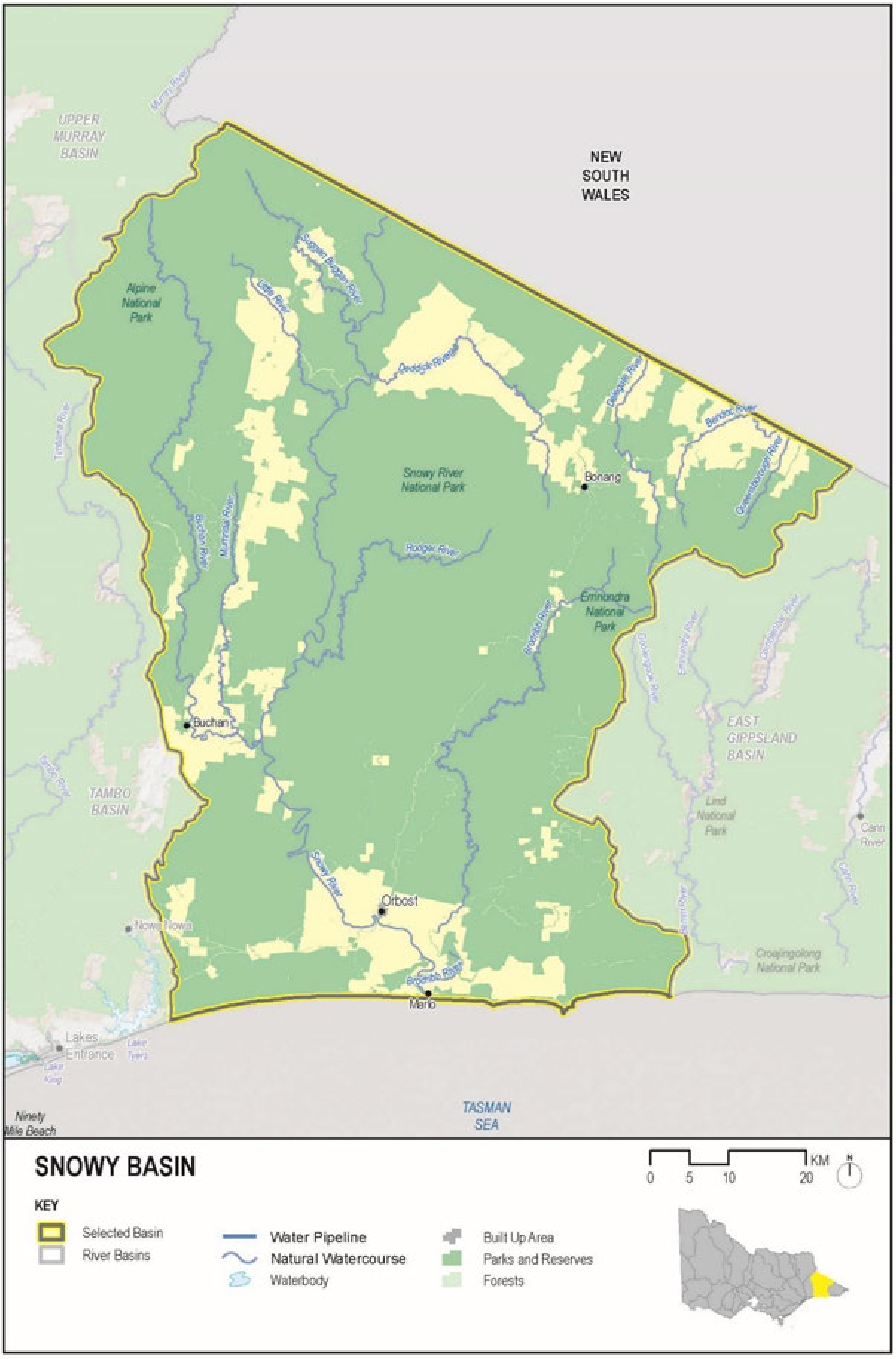
Table 6-56 Volume and use of recycled water in the East Gippsland basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled (excludes within plant process)	Type of end use (ML)				Volume discharged to the environment	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	23	23	100%	0	23	0	0	0	0
Mallacoota	100	100	100%	0	100	0	0	0	0
Total 2016–17	**130**	**130**	**100%**	**0**	**130**	**0**	**0**	**0**	**0**
Total 2015–16	100	100	100%	0	100	0	0	0	0

6.10 Snowy basin

Victoria's Snowy basin (Figure 6-18) 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 6-18 Map of the Snowy basin



6.10.1 Water resources overview

In 2016–17, rainfall across the entire Snowy basin was 80% to 100% of the long-term average.

Catchment inflows to the Victorian Snowy basin were above-average again in 2016–17 (166%) but lower than the previous year (189%). Total inflows were 2,101,279 ML, compared to 2,594,278 ML in the previous year. Consumptive water use in the Victorian Snowy basin is generally low, compared to the total water resource, and more than 99% of the basin's total inflows for 2016–17 flowed into Bass Strait.

All unregulated streams remained unrestricted and there were no urban water use restrictions applied in the Snowy basin in 2016–17, with all towns remaining on permanent water-saving rules throughout the year.

Table 6-57 shows the responsibilities of the authorities within the Victorian portion of the Snowy basin.

Table 6-57 Responsibilities for water resources management in the Snowy basin

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Southern Rural Water	Manages surface water licensed diversions		
East Gippsland Water		Supplies towns including Buchan, Orbost and Marlo	Obliged to meet passing flow requirements
Victorian Environmental Water Holder			Manages entitlements for the environment held in trust for the Snowy River
East Gippsland Catchment Management Authority			Manages waterways for the whole of the Snowy basin

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 such as 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 2016–17, 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.

6.10.2 Surface water resources

6.10.2.1 Water balance

The total volumes of water available and supplied from water resources in the Snowy basin in 2016–17 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.

No storage information is recorded in the water balance as there are no major on-stream storages in the Snowy basin.

Catchment inflows from the Victorian portion of the basin accounted for 81% of the total inflows to the Snowy basin. The volume of water diverted represents less than 1% of the total inflows.

Table 6-58 Balance of surface water in the Snowy basin

Water account component	2016–17 (ML)	2015–16 (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 from Victoria [(1)]	1,691,959	1,927,323
Catchment inflow from NSW [(2)]	409,320	666,955
Rainfall on major storages	-	-
Treated effluent discharged back to river	0	0
Total inflows	**2,101,279**	**2,594,278**
Outflows		
Diversions		
Urban diversions	680	718
Licensed diversions from unregulated streams	473	471
Small catchment dams	2,811	2,811
Total diversions	***3,964***	***4,000***
Losses		
Evaporation losses from major storages	-	-
Evaporation from small catchment dams	685	685
In-stream infiltration to groundwater, flows to floodplain and evaporation [(3)]	n/a	n/a
Total losses	***685***	***685***
Water passed at outlet of basin		
River outflows to the ocean	2,096,630	2,589,593
Total water passed at outlet of basin	***2,096,630***	***2,589,593***
Total outflows	**2,101,279**	**2,594,278**

Notes

(1) Catchment inflows from Victoria is the balancing item in this water balance. It is the difference between the total outflows and the known inflows.
(2) Catchment inflows from New South Wales recorded on the Snowy River at Burnt Hut Crossing (gauge 222013).
(3) No suitable model is available to make an estimate of in-stream losses.

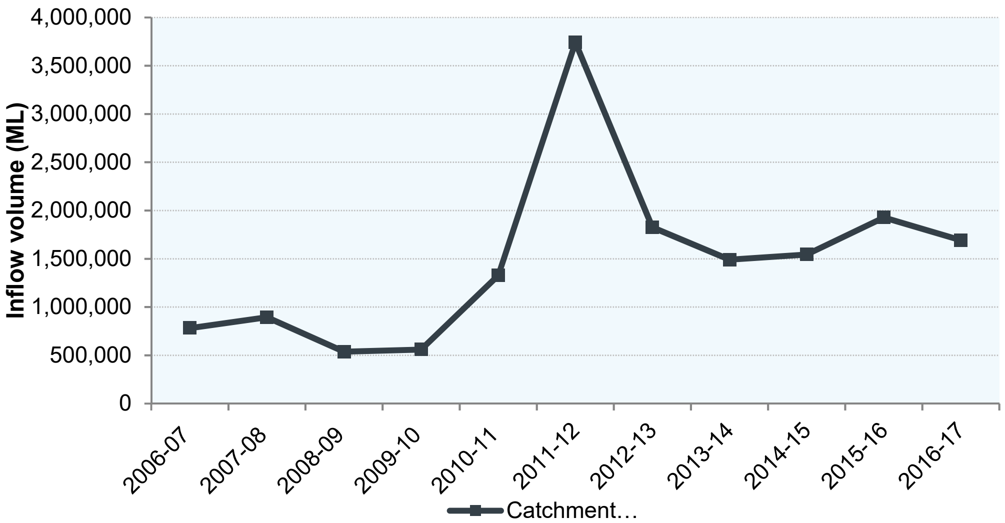
6.10.2.2 Storages and flows

Catchment inflows from the Victorian portion of the basin in 2016–17 were 1,691,959 ML, or 166% of the long-term average (of 1,022,000 ML), compared to 1,927,323 ML, or 189% of the long-term average in 2015–16 (Figure 6-19). Inflows from New South Wales are regulated by the Snowy Mountains Hydro-Electric Scheme. These inflows were 409,320 ML in 2016–17, down from 666,955 ML in 2015–16.

The amount of water flowing from the Snowy basin into Bass Strait was 2,096,630 ML in 2016–17. This represents over 99% of total inflows to the basin.

There are no major storages located within the Victorian portion of the Snowy basin.

Figure 6-19 Catchment inflows in the Snowy basin (including contribution from New South Wales)



6.10.2.3 Entitlement volumes and diversions

In the Snowy basin, surface water is diverted by East Gippsland Water and licensed diverters, and it is also harvested in small catchment dams.

Entitlements include rights granted to individuals (take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water authorities or the VEWH). Rights to water in the Snowy basin are outlined in Table 6-59.

Table 6-59 Entitlement volumes in the Snowy basin

Water entitlements	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	3,958
Total volume of water entitlements in the Snowy basin	**6,159**

Allocation available under bulk entitlements and licences for 2016–17 is presented in Table 6-60. The total volume of water diverted by bulk entitlement holders was similar to amount reported in the *Victorian Water Accounts 2015–16*.

As in previous years, the volume of water diverted from unregulated streams by take and use licence holders in the Snowy basin remains significantly lower than the total licence volume. The volume of water diverted from unregulated streams by licence holders in the Snowy basin was 473 ML (Table 6-60) which was similar to the 2015–16 volume of 471 ML.

Table 6-60 Allocation account balance summary for the Snowy basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Buchan	170	0	25	145
Orbost system	2,031	0	655	1,376
Take and use licences - unregulated surface water	3,962	0	473	3,490
Total 2016–17	**6,163**	**0**	**1,153**	**5,011**
Total 2015–16	6,163	0	1,189	4,975

The estimated volume of water harvested from small catchment dams represents the largest diversion of water in the Snowy basin (Table 6-61). The capacity of small catchment dams is estimated based on GIS mapping. The GIS data used to derive the capacity values for small catchment dams was updated in 2015–16, to provide a more-accurate measure.

Table 6-61 Estimated small catchment dam information for the Snowy basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	2,948	1,474	n/a
Registered commercial and irrigation	1,592	1,337	n/a
Total	**4,540**	**2,811**	**3,496**

n/a Information not available.

6.10.3 Recycled water

East Gippsland Water operates the sole wastewater treatment plant in the Snowy basin. As with 2015–16, 100% of wastewater was recycled in 2016–17 and used for agricultural applications including pasture and tree plantations. However, there was a decrease in the volume of water produced from the previous year.

Table 6-62 shows the volumes and uses of recycled water in the Snowy basin in 2016–17. Where water has been recycled within the plant process, this volume has not been included in the percent recycled value.

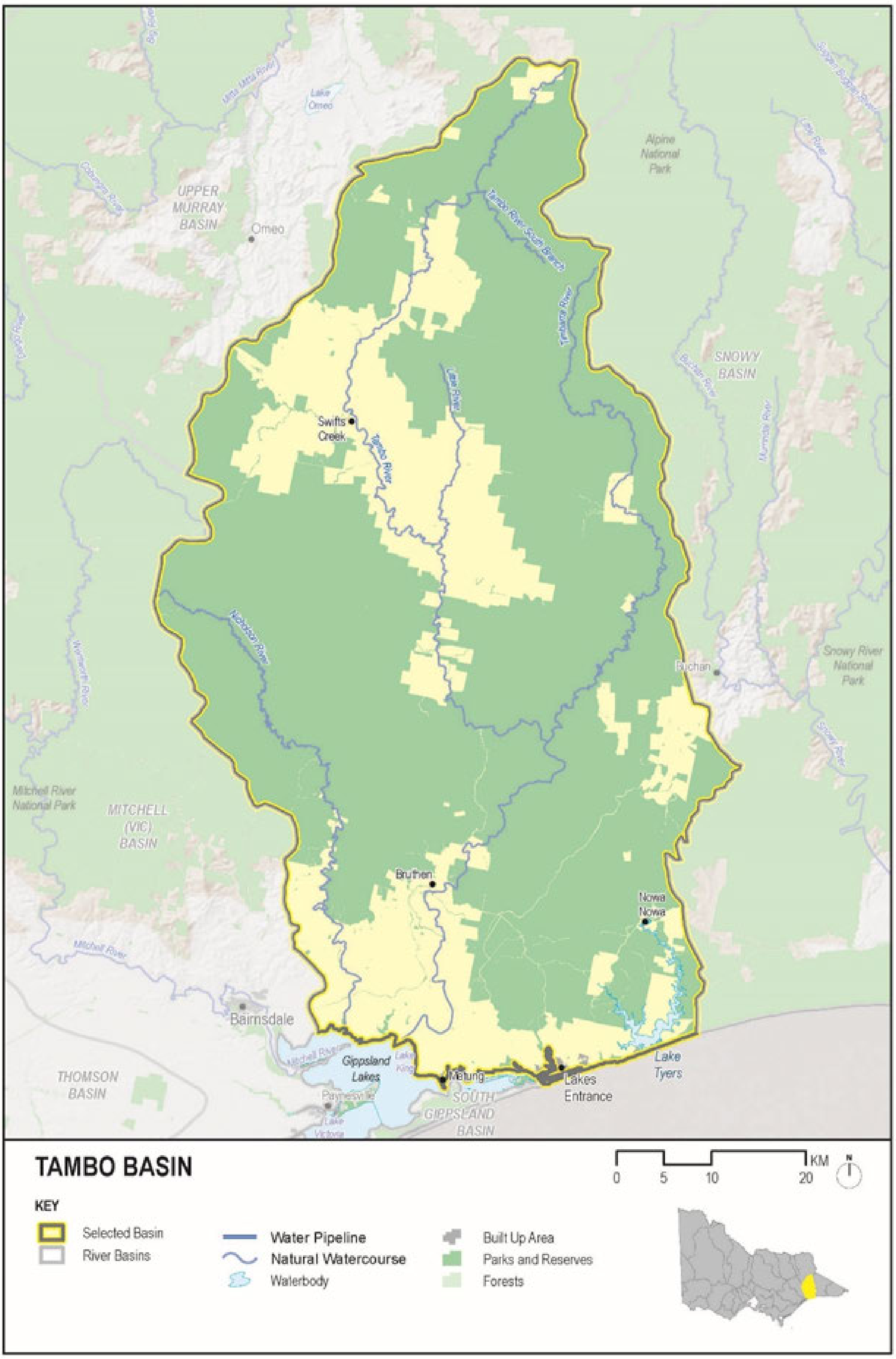
Table 6-62 Volume and use of recycled water in the Snowy basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled (excludes within plant process)	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	237	237	100%	0	237	0	0	0	0
Total 2016–17	**237**	**237**	**100%**	**0**	**237**	**0**	**0**	**0**	**0**
Total 2015–16	394	394	100%	0	394	0	0	0	0

6.11 Tambo basin

The Tambo basin (Figure 6-20) is located in south-east Victoria. The basin contains the Tambo River and the Nicholson River, which flow into the Gippsland Lakes.

Figure 6-20 Map of the Tambo basin



6.11.1 Water resources overview

In 2016–17, rainfall in most of the Tambo basin was between 80% and 100% of the long-term average. A small pocket in the north received 100% to 125% of the long-term average, and a small pocket in the south bordering the Mitchell basin received 60% to 80% of the long-term average.

Catchment inflows were 120% of the long-term average of 297,800 ML, which is a decrease from 146% reported in 2015–16. There are no large authorised diversions in the Tambo basin. Larger towns (such as Lakes Entrance) are supplied by the Bairnsdale water system (sourcing water from the Mitchell basin). Therefore, about 98% of the basin inflows passed through to the Gippsland Lakes in 2016–17.

Rural use from unregulated streams in the basin remained unrestricted during 2016–17. There were also no urban water use restrictions applied in the Tambo basin in 2016–17, and all towns were on permanent water-saving rules throughout the year.

Table 6-63 shows the responsibilities of the authorities within the Tambo basin.

Table 6-63 Responsibilities for water resources management in the Tambo basin

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Southern Rural Water	Manages licensed diversions		
East Gippsland Water		Towns including Lakes Entrance, Bruthen and Swifts Creek are supplied from neighbouring basins	Obliged to meet passing flow requirements
East Gippsland Catchment Management Authority			Manages waterways in the whole of the Tambo basin

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 2016–17, 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.

6.11.2 Surface water resources

6.11.2.1 Water balance

The total volumes of water available and supplied from water resources in the Tambo basin in 2016–17 are shown in Table 6-64. Consumptive use in the Tambo basin is low, compared to the available resource in the basin.

No storage information is recorded in the water balance as there are no major on-stream storages in the Tambo basin.

Table 6-64 Balance of surface water in the Tambo basin

Water account component	2016–17 (ML)	2015–16 (ML)
Major on-stream storage		
Volume in storage at start of year	-	-
Volume in storage at end of year	-	-
Change in storage	**0**	**0**
Inflows		
Catchment inflow (1)	358,443	435,656
Rainfall on major storages	-	-
Treated wastewater discharged back to river	0	0
Total inflows	**358,443**	**435,656**
Outflows		
Diversions		

Urban diversions	24	24
Licensed diversions from unregulated streams	245	228
Small catchment dams	3,661	3,661
Total diversions	***3,930***	***3,913***
Losses		
Evaporation losses from major storages	-	-
Evaporation from small catchment dams	2,179	2,179
In-stream infiltration to groundwater, flows to floodplain and evaporation (2)	n/a	n/a
Total losses	***2,179***	***2,179***
Water passed at outlet of basin		
River outflows to the ocean	352,334	429,564
Total water passed at outlet of basin	***352,334***	***429,564***
Total outflows	**358,443**	**435,656**

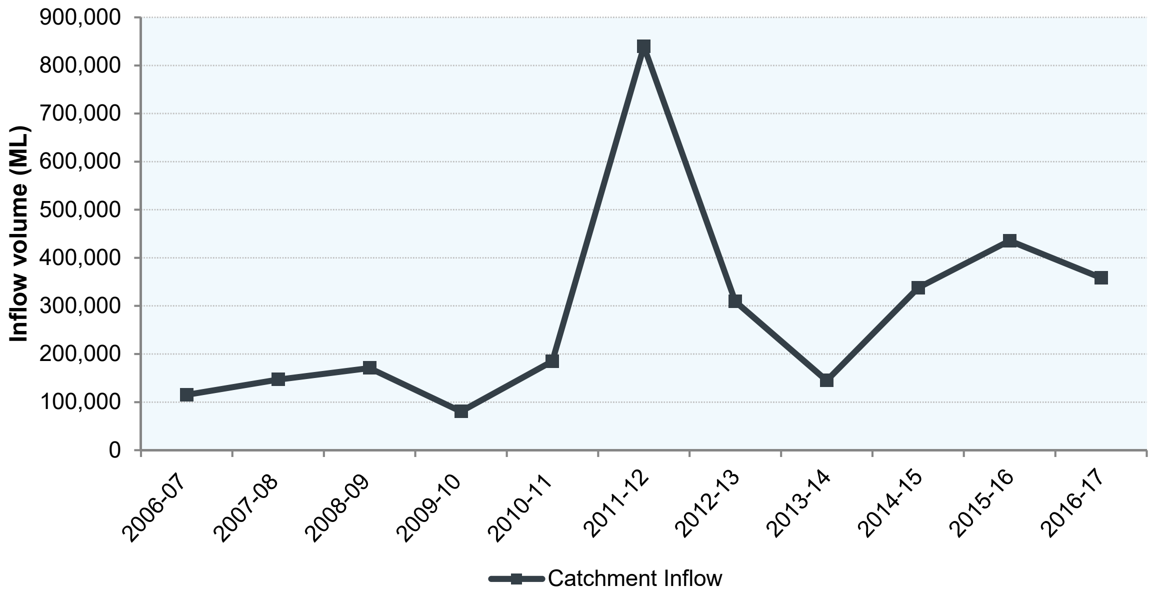
Notes
(1) Catchment inflows is the balancing item in this water balance. It is the difference between the total outflows and the known inflows.
(2) No suitable model is available to make an estimate of in-stream losses.

6.11.2.2 Storages and flows

Catchment inflows were 358,443 ML, 120% of the long-term average of 297,800 ML. This is a decrease from 146% reported in 2015–16, although it is the third-highest inflow year in the last decade (Figure 6-21). The amount of water flowing from the Tambo basin into the Gippsland Lakes was 352,334 ML in 2016–17, which was about 98% of total inflows into the basin.

There are no major storages located within the Tambo basin.

Figure 6-21 Catchment inflows in the Tambo basin



6.11.2.3 Entitlement volumes and diversions

In the Tambo basin, surface water is diverted by East Gippsland Water and licensed diverters, and water is also harvested in small catchment dams.

Entitlements in the Tambo basin include rights granted to individuals (take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water authorities or the VEWH). Rights to water in the Tambo basin are outlined in Table 6-65.

Table 6-65 Entitlement volumes in the Tambo basin

Water entitlements	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	4,119
Total volume of water entitlements in Tambo basin	**4,461**

Allocation available under bulk entitlements and licences for 2016–17 is presented in Table 6-66.

The volume of water diverted from unregulated streams by licence holders in the Tambo basin (245 ML) was more in 2016–17 than the volume reported for 2015–16 (228 ML).

Table 6-66 Allocation account balance summary for the Tambo basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Nowa Nowa [(1)]	118	0	0	118
Swifts Creek	224	0	24	200
Take and use licences - unregulated surface water	4,150	0	245	3,905
Total 2016–17	**4,492**	**0**	**269**	**4,223**
Total 2015–16	4,492	0	252	4,240

Note

(1) No water was taken under the Nowa Nowa bulk entitlement in 2016–17. East Gippsland Water supplied this town under the Bairnsdale bulk entitlement, reported in Table 6-71 in the Mitchell basin.

The estimated volume of water harvested from small catchment dams represents the largest diversion of water in the Tambo basin (Table 6-67). The capacity of small catchment dams for Tambo basin is estimated based on GIS mapping. The GIS data used to derive the capacity values for small catchment dams was updated in 2015–16, to provide a more-accurate measure.

Table 6-67 Estimated small catchment dam information for the Tambo basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	5,088	2,544	n/a
Registered commercial and irrigation	1,330	1,117	n/a
Total	**6,418**	**3,661**	**5,840**

n/a Information not available.

6.11.3 Recycled water

East Gippsland Water operates the wastewater treatment plants within the Tambo basin. As with 2015–16, 100% of wastewater passing through these treatment plants was recycled in 2016–17 and used for agricultural applications including pasture, tree plantations, racecourses and golf courses.

Table 6-68 shows the volumes and uses of recycled water in the Tambo basin in 2016–17. Where water has been recycled within the plant process, this volume has not been included in the percent recycled value.

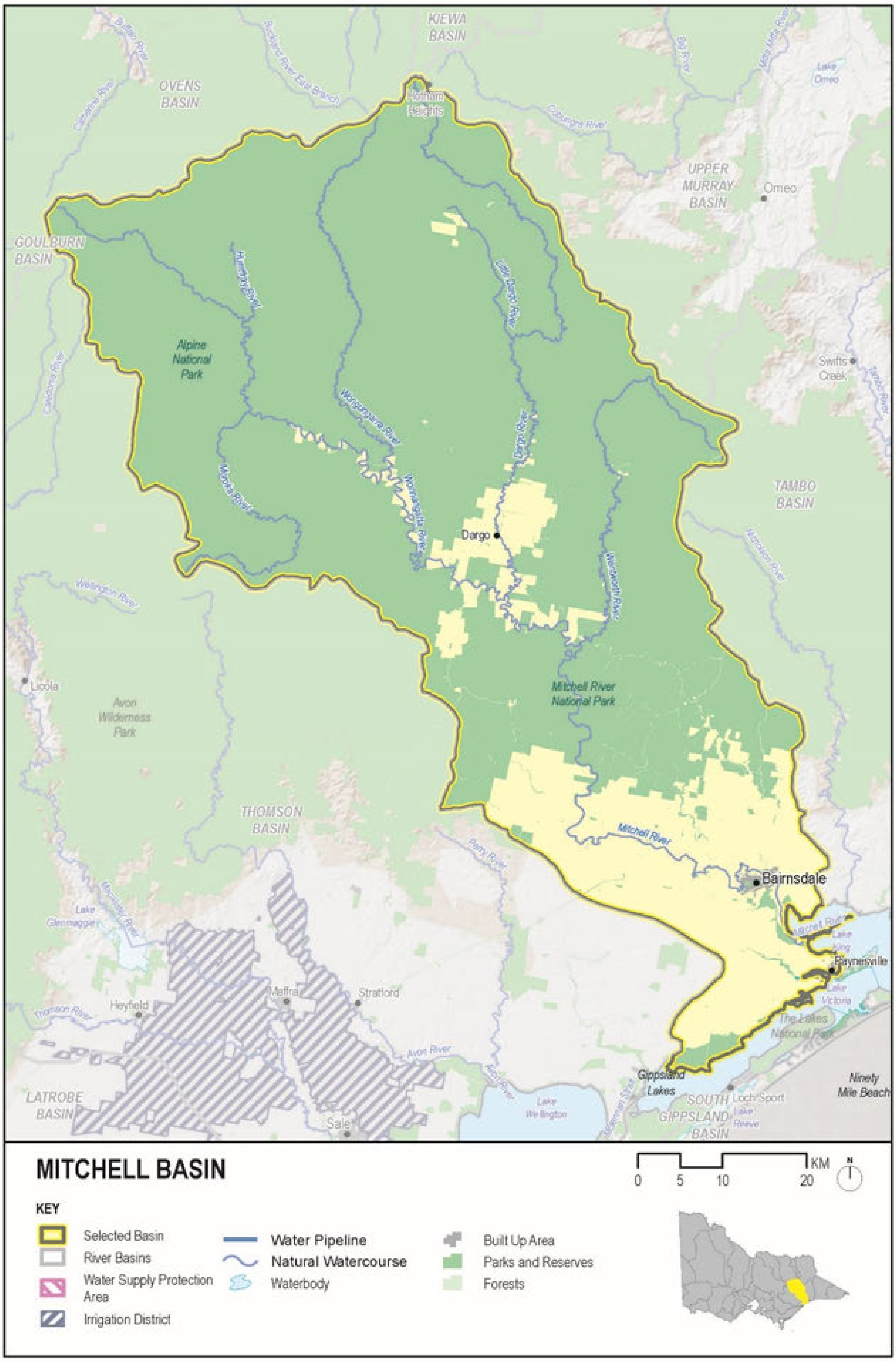
Table 6-68 Volume and use of recycled water in the Tambo basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled (excludes within plant process)	Type of end use (ML)				Volume discharged to the environment	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Lakes Entrance	725	725	100%	0	725	0	0	0	0
Metung	157	157	100%	0	157	0	0	0	0
Total 2016–17	**882**	**882**	**100%**	**0**	**882**	**0**	**0**	**0**	**0**
Total 2015–16	954	954	100%	0	954	0	0	0	0

6.12 Mitchell basin

The Mitchell basin (Figure 6-22) is located in south-east Victoria. The Mitchell River flows into the Gippsland Lakes near Bairnsdale.

Figure 6-22 Map of the Mitchell basin



6.12.1 Water resources overview

In 2016–17, rainfall in most of the Mitchell basin was between 80% and 100% of the long-term average. Up to 125% was received in the very north of the basin, and a small pocket in the south bordering the Tambo basin received 60% to 80% of the long-term average.

Catchment inflows in the Mitchell basin were 120% of the long-term average of 884,500 ML, more than double the 58% in 2015–16. Consumptive use in the basin is generally low when compared to the total water resource. About 98% of the total inflows were not diverted and therefore entered the Gippsland Lakes.

Licensed diversions from the Mitchell River were restricted from 27 February to 26 March 2017, when flows fell below the trigger levels defined in the *Mitchell River Basin Local Management Plan*. Restrictions were at stage 1 for 14 days and at stage 3 for 13 days. There were no urban water use restrictions applied in the Mitchell basin in 2016–17, with all towns remaining on permanent water-saving rules throughout the year.

Table 6-69 shows the responsibilities of the authorities within the Mitchell basin.

Table 6-69 Responsibilities for water resources management in the Mitchell basin

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Southern Rural Water	Manages licensed diversions		
East Gippsland Water		Supplies towns including Bairnsdale, Lakes Entrance and Paynesville	Obliged to meet passing flow requirements
East Gippsland Catchment Management Authority			Manages waterways in the Mitchell basin

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 2016–17, 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.

6.12.2 Surface water resources

6.12.2.1 Water balance

The total volumes of water available and supplied from water resources in the Mitchell basin in 2016–17 are shown in Table 6-70. Diversions make up a relatively small proportion of total inflows, with about 2% of the total basin inflows diverted for consumptive use.

No storage information is recorded in the water balance as there are no major on-stream storages in the Mitchell basin.

Table 6-70 Balance of surface water in the Mitchell basin

Water account component	2016–17 (ML)	2015–16 (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)	1,060,803	514,486
Rainfall on major storages	-	-
Treated wastewater discharged back to river (2)	209	138
Total inflows	**1,061,012**	**514,624**
Outflows		

Diversions		
Urban diversions	4,537	4,104
Licensed diversions from unregulated streams	9,974	7,508
Small catchment dams	4,517	4,517
Total diversions	***19,029***	***16,129***
Losses		
Evaporation losses from major storages	-	-
Evaporation from small catchment dams	950	950
In-stream infiltration to groundwater, flows to floodplain and evaporation	475	237
Total losses	***1,426***	***1,187***
Water passed at outlet of basin		
River outflows to the Gippsland Lakes	1,040,558	497,308
Total water passed at outlet of basin	***1,040,558***	***497,308***
Total outflows	**1,061,012**	**514,624**

Notes

(1) Catchment inflows is the balancing item in this water balance. It is the difference between the total outflows and the known inflows.

(2) Includes returns from the Mt Hotham Alpine Resort to Dargo River.

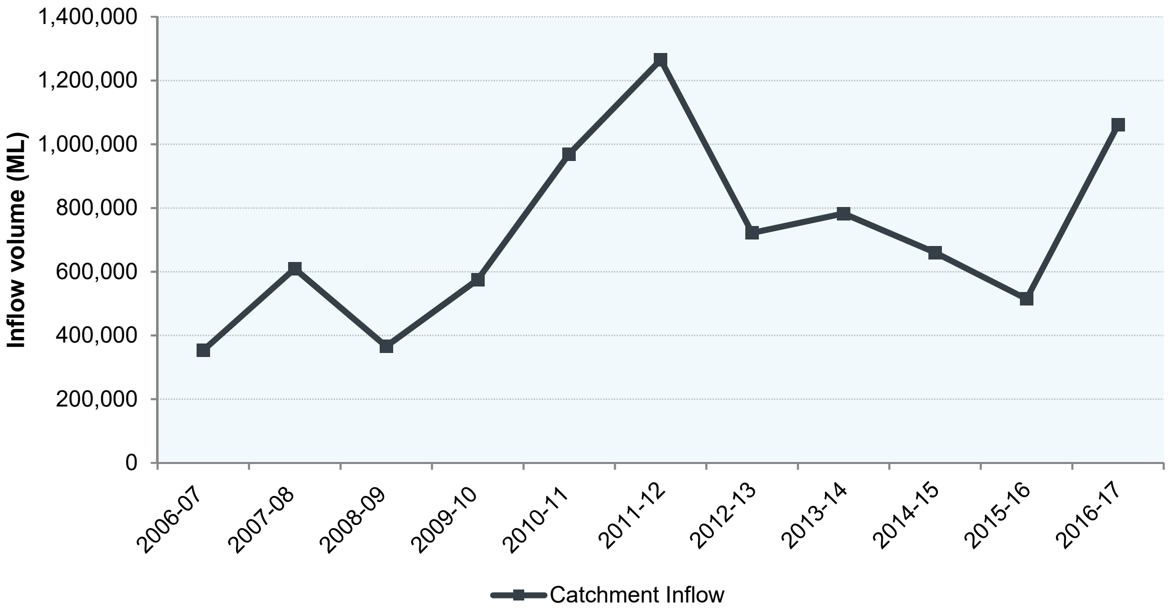
6.12.2.2 Storages and flows

Catchment inflows to the basin were 120% (1,060,803 ML) of the long-term average, more than double the 58% (514,485 ML) recorded in 2015–16 (Figure 6-23). These were the second-highest annual inflows recorded in the basin over the last decade.

The amount of water flowing from the Mitchell basin into the Gippsland Lakes was1,040,558 ML in 2016–17, which is 98% of the total inflows into the basin. This is a large increase from 497,308 ML recorded in 2015–16.

There are no major storages located within the Mitchell basin.

Figure 6-23 Catchment inflows in the Mitchell basin



6.12.2.3 Entitlement volumes and diversions

In the Mitchell basin, surface water is diverted by East Gippsland Water and licensed diverters, and harvested in small catchment dams. The total volume of take and use licences in the Mitchell basin includes licences for irrigation as well as for domestic and stock purposes.

East Gippsland Water holds one bulk entitlement in the Mitchell basin, used to supply Bairnsdale, Lakes Entrance, Bruthen and surrounding towns.

Entitlements include rights granted to individuals (take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water authorities or the VEWH). Rights to water in the Mitchell basin are outlined in Table 6-71.

Table 6-71 Entitlement volumes in the Mitchell basin

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (Bairnsdale) Conversion Order 2000	9,208
Take and use licences - unregulated surface water	16,385
Total volume of water entitlements in the Mitchell basin	**25,593**

Allocation available under bulk entitlements and licences for 2016–17 is presented in Table 6-72.

The volume of water diverted from unregulated streams by licence holders in the Mitchell basin (9,974 ML) was more in 2016–17 than the volume (7,508 ML) reported in the *Victorian Water Accounts 2015–16*.

Table 6-72 Allocation account balance summary for the Mitchell basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Bairnsdale	9,208	0	4,537	4,671
Take and use licences - unregulated surface water	16,385	0	9,974	6,411
Total 2016–17	**25,593**	**0**	**14,511**	**11,082**
Total 2015–16	25,593	0	11,612	13,981

The estimated volume of water harvested from small catchment dams is presented in Table 6-73. The capacity of small catchment dams for Mitchell basin is estimated based on GIS mapping. The GIS data used to derive the capacity values for small catchment dams was updated in 2015–16, to provide a more-accurate measure.

Table 6-73 Estimated small catchment dam information for the Mitchell basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	4,031	2,016	n/a
Registered commercial and irrigation	2,978	2,502	n/a
Total	**7,009**	**4,517**	**5,467**

n/a Information not available.

6.12.3 Recycled water

East Gippsland Water operates all treatment plants within the Mitchell basin. About 92% of wastewater produced was recycled in 2016–17, a slight decrease from 96% in 2015–16. All of the wastewater passing through the Bairnsdale and Lindenow treatment plants was recycled in 2016–17. In addition, 68 ML was returned from the Mount Hotham Alpine Resort to Dargo River during the water year.

The Bairnsdale wastewater treatment plant has, as part of its treatment process, a series of constructed wetlands located within the Macleod Morass. The constructed wetlands provide additional filtration for water discharged from the treatment plant, before it is released into the morass as environmentally beneficial water for the deep freshwater marsh. This discharge is considered a beneficial allocation.

Table 6-74 shows the volumes and uses of recycled water in the Mitchell basin in 2016–17. Where water has been recycled within the plant process, this volume has not been included in the percent recycled value.

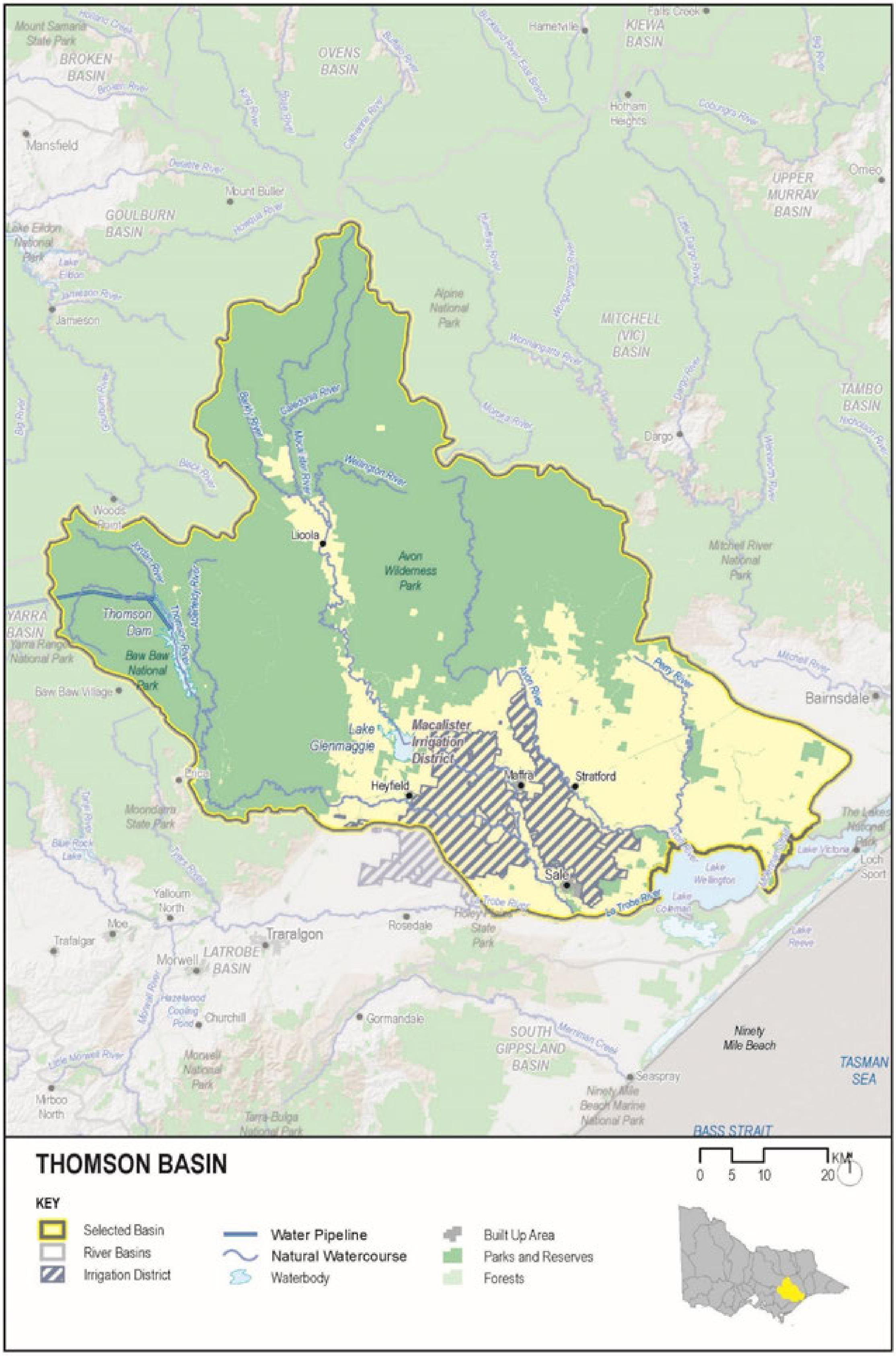
Table 6-74 Volume of recycled water in the Mitchell basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled (excludes within plant process)	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	1,275	1,275	100%	0	21	1,254	0	0	0
Lindenow	9	9	100%	0	0	9	0	0	0
Paynesville	425	284	67%	0	284	0	0	141	0
Total 2016–17	**1,709**	**1,568**	**92%**	**0**	**305**	**1,263**	**0**	**141**	**0**
Total 2015–16	1,710	1,640	96%	0	355	1,286	0	71	0

6.13 Thomson basin

The Thomson basin (Figure 6-24) is located in south-east Victoria. The Thomson and Macalister rivers join the Latrobe River before flowing into the Gippsland Lakes.

Figure 6-24 Map of the Thomson basin



6.13.1 Water resources overview

In 2016–17, rainfall throughout the Thomson basin was mostly 80% to 100% of the long-term average. A large area over Glenmaggie received between 60% to 80% of the long-term average, and up to 125% was received in the northernmost point of the basin.

Catchment inflows were 87% of the long-term average of 1,101,760 ML, compared to 51% in 2015–16. The amount of water flowing from the Thomson basin into the Gippsland Lakes represented 63% of the total inflows in the basin in 2016–17.

Major storages in the Thomson basin started and ended the year at the same level: 55% of capacity.

Pumping restrictions were introduced on the Avon River in mid-December and January on Valencia Creek. With little to no rainfall from mid-January to March, both systems experienced low flows, with stage 4 restrictions being placed on the Avon River and stage 1 on the Valencia Creek. A brief spell of rainfall around March allowed restrictions to be eased, with stage 1 and 2 restrictions being introduced for both systems until the end of the irrigation season. From February to mid-April, a local roster was also introduced for irrigators on the lower end of Freestone Creek due to low flows.

There were no urban water-use restrictions applied in the Thomson basin in 2016–17, with all towns remaining on permanent water-saving rules throughout the year.

Table 6-75 shows the responsibilities of the authorities within the Thomson basin.

Table 6-75 Responsibilities for water resources management in the Thomson basin

Authority	Irrigation and rural water supply	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
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 Obliged to meet passing flow requirements
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 Obliged to meet passing flow requirements
Gippsland Water			Supplies towns including Sale, Maffra, Heyfield, Stratford and Boisdale	
Victorian Environmental Water Holder				Holds and manages entitlements for the environment in the basin
West Gippsland Catchment Management Authority				Manages waterways in the Thomson basin

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 2016–17, 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 released from the Thomson Reservoir
- 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 2016–17, a total of 16,925 ML of held environmental water was delivered in-stream in the Thomson basin.

6.13.2 Surface water resources

6.13.2.1 Water balance

The total volumes of water available and supplied from water resources in the Thomson basin in 2016–17 are shown in Table 6-76. Irrigation water use in the Macalister Irrigation District comprised the majority of diversions within the basin.

A total volume of 185,908 ML was diverted to irrigation districts in 2016–17, higher than in 2015–16. Melbourne Water's transfer from the Thomson Reservoir to the Greater Yarra system – Thomson River Pool decreased to 86,383 ML in 2016–17.

Table 6-76 Balance of surface water in the Thomson basin

Water account component	2016–17 (ML)	2015–16 (ML)
Major on-stream storage		
Volume in storage at start of year	678,930	888,496
Volume in storage at end of year	690,671	678,930
Change in storage	**11,741**	**(209,566)**
Inflows		
Catchment inflow (1) (2)	962,204	559,704
Rainfall on major storages	22,866	23,965
Return flow from irrigation	2,085	16,629
Treated wastewater discharged back to river (2)	28	26
Total inflows	**987,183**	**600,323**
Outflows		
Diversions		
Urban diversions	1,398	1,484
Transfers to Yarra basin for urban use	86,383	247,098
Irrigation district diversions	185,908	167,574
Licensed diversions from regulated streams	22,040	17,920
Licensed diversions from unregulated streams	4,611	4,991
Small catchment dams	5,475	5,475
Total diversions	***305,815***	***444,542***
Losses		
Evaporation losses from major storages	29,822	30,360
Evaporation from small catchment dams	2,398	2,398
In-stream infiltration to groundwater, flows to floodplain and evaporation	15,466	12,656
Total losses	***47,685***	***45,414***
Water passed at outlet of basin		
River outflows to Latrobe River (3)	446,042	227,933
River outflows to Lake Wellington (4)	175,900	92,001
Total water passed at outlet of basin	***621,942***	***319,934***
Total outflows	**975,442**	**809,889**

Notes

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

(2) The 'Treated wastewater discharged back to river' value was incorrectly published in the 2015–16 accounts as 52 ML. This affected the balancing item 'Catchment inflows'. The 2015–16 Catchment inflows value was incorrectly published in the 2015–16 accounts as 559,677 ML.

(3) Outflows from the Latrobe River flow into Lake Wellington.

(4) River outflows to Lake Wellington include a Perry River volume of 31,418 ML.

6.13.2.2 Storages and flows

The volume of water held in major storages was 690,671 ML (55% of capacity) at the end of June 2017, similar to the 678,930 ML at the start of July 2016.

In the Thomson basin, major on-stream storages include the Thomson Reservoir and Lake Glenmaggie. Melbourne's biggest water storage, the Thomson Reservoir, began the year at 56% of capacity and ended the year slightly higher at 60%. Lake Glenmaggie started the year at 46% and ended the year at almost half of that, with a volume 46,215 ML, which is 26% of its total capacity.

The volume reported in the 'Catchment inflows less regulated releases' column in Table 6-77 is the balancing item for each storage. It represents the flows of water in or out of the storage that are not shown as rainfall or evaporation and may include other minor components influencing the change in storage during the year.

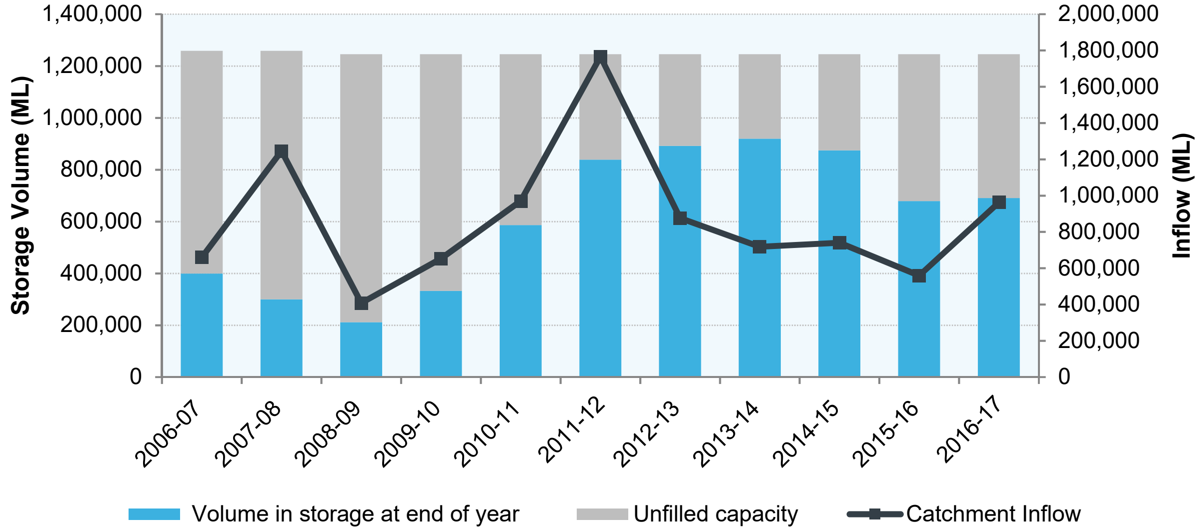
Table 6-77 Storage volumes in the Thomson basin

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	81,017	8,901	12,288	(31,415)	46,215
Thomson Reservoir	1,068,000	597,913	13,965	17,534	50,112	644,456
Total storage volumes	**1,245,640**	**678,930**	**22,866**	**29,822**	**18,697**	**690,671**

Note
(1) Volumes in store in the Thomson do not include 55,100 ML of volume in dead storage.

Catchment inflows to the Thomson basin amounted to 962,204 ML in 2016–17, which is 87% of the long-term average of 1,101,760 ML (Figure 6-25). The amount of water flowing from the Thomson basin into the Gippsland Lakes in 2016–17 was 621,942 ML, compared to 319,934 ML in 2015–16. This represents 63% of catchment inflows into the basin for 2016–17.

Figure 6-25 Storage volumes and catchment inflows in the Thomson basin



6.13.2.3 Entitlement volumes and diversions

Southern Rural Water, Gippsland Water, Melbourne Water and the VEWH hold bulk entitlements in the Thomson basin.

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 subchapter. Surface water is also diverted by licensed diverters and is harvested in small catchment dams.

Entitlements include rights granted to individuals (for example, water shares and take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations or the VEWH). Rights to water in the Thomson basin are outlined in Table 6-78.

Table 6-78 Entitlement volumes in the Thomson basin

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (Thomson Macalister - Southern Rural Water) Conversion Order 2001 (1)	
High-reliability water shares	150,035
Low-reliability water shares	71,726
Bulk Entitlement (Thomson Macalister Towns - Gippsland Water) Conversion Order 2005	2,335
Macalister River Environmental Entitlement 2010	18,690
Sub-total: Bulk Entitlement (Thomson Macalister - Southern Rural Water) Conversion Order 2001	**242,787**
Bulk Entitlement (Thomson River – Melbourne Water) Order 2014 (2)	171,800
Bulk Entitlement (Thomson River - Environment) Conversion Order 2005 (3)	
High-reliability component	10,000
Share of inflows	n/a
Sub-total: Bulk Entitlement (Thomson Macalister - Southern Rural Water) Conversion Order 2001	**10,000**

Take and use licences - unregulated surface water	17,237
Total volume of water entitlements in the Thomson basin	**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) 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.

(3) 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.

Allocation available under bulk entitlements and licences for 2016–17 is presented in Table 6-79. The total volume of water diverted by bulk entitlement holders was lower in 2016–17, compared to the volume reported in the *Victorian Water Accounts 2015–16*.

The VEWH holds environmental entitlements for the Thomson River and Macalister River. Water available under these entitlements is used to support streamflows and is not diverted out of waterways in the basin. It has therefore not been included as part of the water balance diversions in Table 6-76.

Table 6-79 Allocation account balance summary for the Thomson basin

Water entitlement	Allocation issued (ML)	Net trade In / (Out) (ML)	Water use (ML)	End of season forfeitures (ML)
Thomson Macalister - Southern Rural Water				
Water shares [(1)]	221,761	0	168,592	53,169
Thomson Macalister Towns - Gippsland Water	2,335	0	1,398	937
Macalister River Environmental Entitlement 2010 [(2) (3)]	16,549	0	6,599	9,950
Operating provisions [(4)]	-	-	37,271	-
Net diversion: Thomson Macalister - Southern Rural Water [(5)]			**207,261**	0
Thomson River - Melbourne Water [(6) (7)]	171,800	0	86,383	85,417
Thomson River - Environment [(3) (8)]	17,763	1	10,326	7,438
Take and use licences - unregulated surface water	17,239	0	4,611	12,629
Total 2016–17	**447,447**	**1**	**308,581**	**169,540**
Total 2015–16	388,043	(1,330)	434,688	(32,282)

Notes

(1) Allocation issued includes 43,375 ML of spill allocation made available to water shares holders in 2016–17.

(2) Allocation issued includes 3,391 ML of water carried over on entitlement, and the volume of 10,499 ML forfeited includes 9,950 ML carried over into 2016–17 and 549 ML of unused carryover written-off. 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 flows from irrigation).

(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 2016–17 was 113,009 ML.

(7) 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 2016–17 was 393,499 ML.

(8) Allocation issued includes 113 ML of water carried over on entitlement and the volume of 7,438 ML recorded as forfeited could be carried over into 2017–18.

The estimated volume of water harvested from small catchment dams in the Thomson basin is shown in Table 6-80. The capacity of small catchment dams for Thomson basin is estimated based on GIS mapping. The GIS data used to derive the capacity values for small catchment dams was updated in 2015–16, to provide a more-accurate measure.

Table 6-80 Estimated small catchment dam information for the Thomson basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	5,508	2,754	n/a
Registered commercial and irrigation	3,239	2,721	n/a
Total	**8,747**	**5,475**	**7,872**

n/a Information not available.

6.13.3 Recycled water

Gippsland Water operates all treatment plants within the Thomson basin. As with 2015–16 about 98% of wastewater was recycled in 2016–17. Recycled water within the basin is mainly used to irrigate pasture and for watering facilities.

Table 6-81 shows the volumes and uses of recycled water in the Thomson basin in 2016–17. Where water has been recycled within the plant process, this volume has not been included in the percent recycled value.

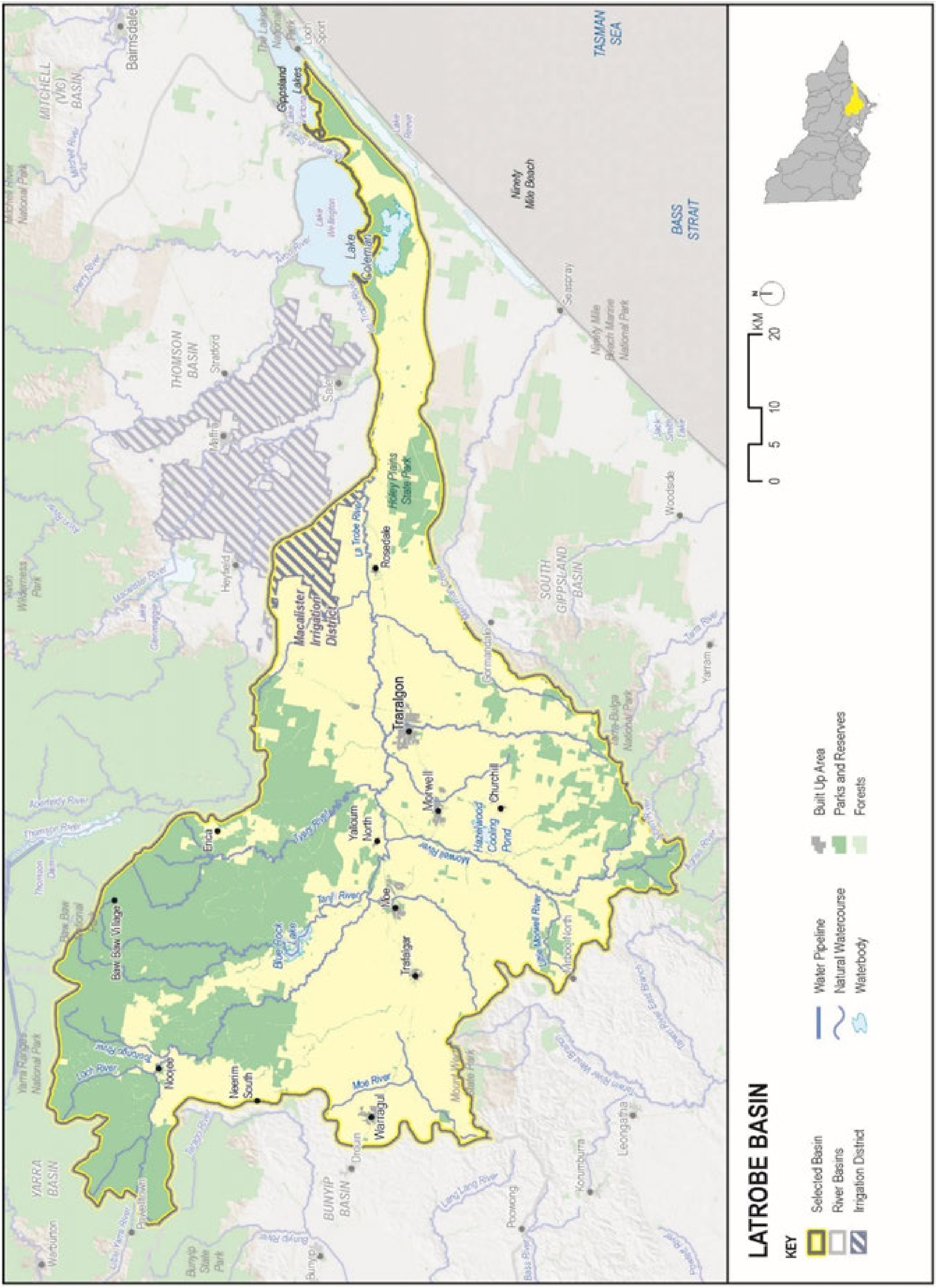
Table 6-81 Volume and use of recycled water in the Thomson basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled (excludes within plant process)	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	81	81	100%	0	81	0	0	0	0
Maffra	286	286	100%	3	282	0	0	0	0
Rawson	28	0	0%	0	0	0	0	28	0
Sale	761	761	100%	0	761	0	0	0	0
Stratford	157	157	100%	0	157	0	0	0	0
Total 2016–17	**1,313**	**1,285**	**98%**	**3**	**1,281**	**0**	**0**	**28**	**0**
Total 2015–16	1,131	1,105	98%	6	1,099	0	0	26	0

6.14 Latrobe basin

The Latrobe basin (Figure 6-26) 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 6-26 Map of the Latrobe basin



6.14.1 Water resources overview

In 2016–17, rainfall throughout the Latrobe basin was mostly 80% to 100% of the long-term average, with a small pocket near Traralgon receiving between 60% to 80% of the long-term average.

Catchment inflows were 75% of the long-term average of 847,400 ML, compared to 65% in 2015–16. The amount of water flowing from the Latrobe basin into the Gippsland Lakes (excluding the Thomson River) represented 82% of the catchment inflows in the basin in 2016–17.

The volume of water in major storages remained high throughout the year, with major storages starting the year at 85% of total capacity and ending the year at 84% of capacity.

With very little rain falling in the catchment, licensed diversions were restricted on Middle Creek from January to April 2017. Low river flows also saw licensed diversion bans in place on the Moe River for over a week in March and rostering in place on the Morwell River from March to April 2017. All other unregulated waterways remained unrestricted.

No urban water use restrictions applied in the Latrobe basin in 2016–17, with all towns remaining on permanent water-saving rules throughout the year.

Table 6-82 shows the responsibilities of the authorities within the Latrobe basin.

Table 6-82 Responsibilities for water resources management in the Latrobe basin

Authority	Irrigation and rural water supply	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
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, power stations and licensed diverters Obliged to meet passing flow requirements
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 Obliged to meet passing flow requirements
Victorian Environmental Water Holder				Holds and manages entitlements for the environment in the basin
West Gippsland Catchment Management Authority				Manages waterways in the Latrobe basin

Water for the environment

The Gippsland Lakes and the Australian grayling population are important environmental assets partially dependent on water in the Latrobe basin. The lakes are listed as internationally significant wetlands under the Ramsar Convention and rely on the freshwater inputs from rivers including the Latrobe River to function ecologically. Australian grayling are listed in the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* and the Victorian *Flora and Fauna Guarantee Act 1988*.

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, Australian grayling and short- and long-finned eel.

The lower Latrobe wetlands (Dowd Morass, Heart Morass and Sale Common) are an important component of the internationally recognised Gippsland Lakes Ramsar site, and provide they 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 2016–17, 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 floodplain wetlands including 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 2016–17 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 2016–17, a total of 3,713 ML of environmental water was delivered in-stream in the Latrobe basin.

6.14.2 Surface water resources

6.14.2.1 Water balance

The total volumes of water available and supplied from water resources in the Latrobe basin in 2016–17 are shown in Table 6-83. The major industrial water users in the basin include electricity generators and Australian Paper. In 2016–17, these entities accounted for about half the surface water diversions in the Latrobe basin. They also returned 40,355 ML to the Latrobe River.

Table 6-83 Balance of surface water in the Latrobe basin

Water account component	2016–17 (ML)	2015–16 (ML)
Major on-stream storage		
Volume in storage at start of year	200,814	244,694
Volume in storage at end of year	198,676	200,814
Change in storage	**(2,138)**	**(43,880)**
Inflows		
Catchment inflow (1)	636,930	552,528
Rainfall on major storages	9,595	8,519
Return flow from power stations and major industry	40,355	37,135
Treated wastewater discharged back to river	3,410	3,450
Total inflows	**690,291**	**601,632**
Outflows		
Diversions		
Urban and industrial diversions	113,713	115,730
Licensed diversions from regulated streams	6,726	6,976
Licensed diversions from unregulated streams	5,766	7,592
Small catchment dams	22,802	22,802
Total diversions	***149,007***	***153,100***
Losses		
Evaporation losses from major storages	12,407	13,670
Evaporation from small catchment dams	5,610	5,610
In-stream infiltration to groundwater, flows to floodplain and evaporation (2)	n/a	n/a
Total losses	***18,017***	***19,280***
Water passed at outlet of basin		
River outflows to the Gippsland Lakes (excluding Thomson River)	525,405	473,132
Total water passed at outlet of basin	***525,405***	***473,132***
Total outflows	**692,429**	**645,512**

Notes

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

(2) No suitable model is available to make an estimate of in-stream losses.

6.14.2.2 Storages and flows

Storage levels for all major storages in the basin totalled 198,676 ML in June 2017 (Table 6-84), compared to 200,814 ML in July 2016. The volume reported in the 'Catchment inflows less regulated releases' column in Table 6-84 is the balancing item for each storage. It represents the flows of water in or out of the storage that are not shown as rainfall or evaporation, and may include other minor components influencing the change in storage during the year.

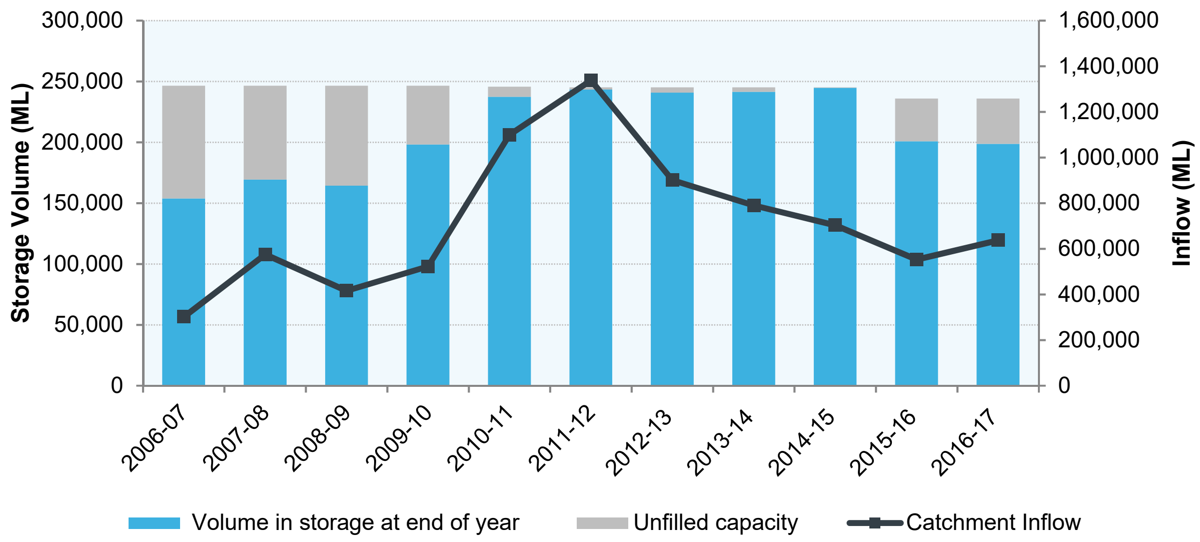
Only volumes for major on-stream storages have been included in the water balance. The largest storage in the basin is Blue Rock Reservoir, which has an operating capacity of 198,280 ML. The volume of water held in Blue Rock Reservoir at the end of the year was 178,139 ML.

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	170,586	6,428	7,659	8,784	178,139
Lake Narracan	7,230	4,394	1,566	1,870	(2,917)	1,173
Moondarra Reservoir	30,458	25,834	1,601	2,878	(5,193)	19,364
Total storage volumes	**235,968**	**200,814**	**9,595**	**12,407**	**674**	**198,676**

Catchment inflows were 75% (636,930 ML) of the long-term average of 847,400 ML, compared to 65% (552,527 ML) in 2015–16 (Figure 6-27). The amount of water flowing from the Latrobe basin into the Gippsland Lakes (excluding the Thomson River) increased to 525,405 ML in 2016–17 from 473,132 ML in 2015–16.

Figure 6-27 Storage volumes and catchment inflows in the Latrobe basin



6.14.2.3 Entitlement volumes and diversions

In the Latrobe basin, surface water is diverted by Gippsland Water, Southern Rural Water, Latrobe Valley power stations, the VEWH and licensed diverters. Surface water is also harvested in small catchment dams.

Entitlements in the Latrobe basin include rights granted to individuals (take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations or the VEWH). Rights to water in the Latrobe basin are outlined in Table 6-85.

Table 6-85 Entitlement volumes in the Latrobe basin

Water entitlements	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)	n/a
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	18,905
Total volume of water entitlements in the Latrobe basin	**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 2016–17 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 Specified volume not applicable.

Allocation available under bulk entitlements for water corporations, VEWH and the Latrobe Valley power stations and licences in 2016–17 is shown in Table 6-86.

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.

Licence holders diverted a volume of 5,766 ML from unregulated streams in 2016–17, less than the 2015–16 volume of 7,592 ML (Table 6-86).

Table 6-86 Allocation account balance summary for the Latrobe basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Blue Rock Environmental Entitlement [1]	18,591	744	3,713	15,622
Boolarra	145	0	0	145
Gippsland Water - Blue Rock	20,000	0	2,701	17,299
Erica	340	0	55	285
Latrobe - Southern Rural Water [2]	12,785	(12)	6,727	6,047
Lower Latrobe Wetlands Environmental Entitlement [3]	-	-	-	-
Mirboo North	270	0	217	53
Moe - Narracan Creek	3,884	0	1,607	2,277
Moondarra Reservoir	62,000	0	47,504	14,496
Noojee [4]	73	0	0	73
Thorpdale	80	0	0	80
Latrobe - Loy Yang B	20,000	0	14,772	5,228
Latrobe - Loy Yang A	40,000	0	20,099	19,901
Latrobe - Loy Lang 3/4 Bench	25,000	0	0	25,000
Yallourn Energy Ltd	36,500	0	26,758	9,742
Latrobe Reserve	-	-	-	-
Take and use licences - unregulated surface water	18,841	12	5,766	13,087
Total 2016–17	**258,509**	**744**	**129,918**	**129,335**
Total 2015–16	258,824	0	134,048	124,776

Notes

(1) Allocation issued reflects the total available water for the year (including opening carryover). 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 1,398 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 2016–17, water under this entitlement was used to inundate Sale Common and Dowd Morass. Volumes delivered 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.

The estimated volume of water harvested from small catchment dams makes up a significant portion of total surface water diversions in the Latrobe basin (Table 6-87). The capacity of small catchment dams for Latrobe basin is estimated based on GIS mapping. The GIS data used to derive the capacity values for small catchment dams was updated in 2015–16, to provide a more-accurate measure.

Table 6-87 Estimated small catchment dam information for the Latrobe basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	12,701	6,351	n/a
Registered commercial and irrigation	19,585	16,451	n/a
Total	**32,286**	**22,802**	**28,412**

n/a Information not available.

6.14.3 Recycled water

Gippsland Water operates all treatment plants within the Latrobe basin. About 3% of wastewater was recycled in 2016–17, which is the same as in 2015–16. The majority of wastewater produced in the basin is highly saline and unsuitable for recycling and was therefore was discharged to Bass Strait.

Table 6-88 shows the volumes and uses of recycled water in the Latrobe basin in 2016–17. Where water has been recycled within the plant process, this volume has not been included in the percent recycled value.

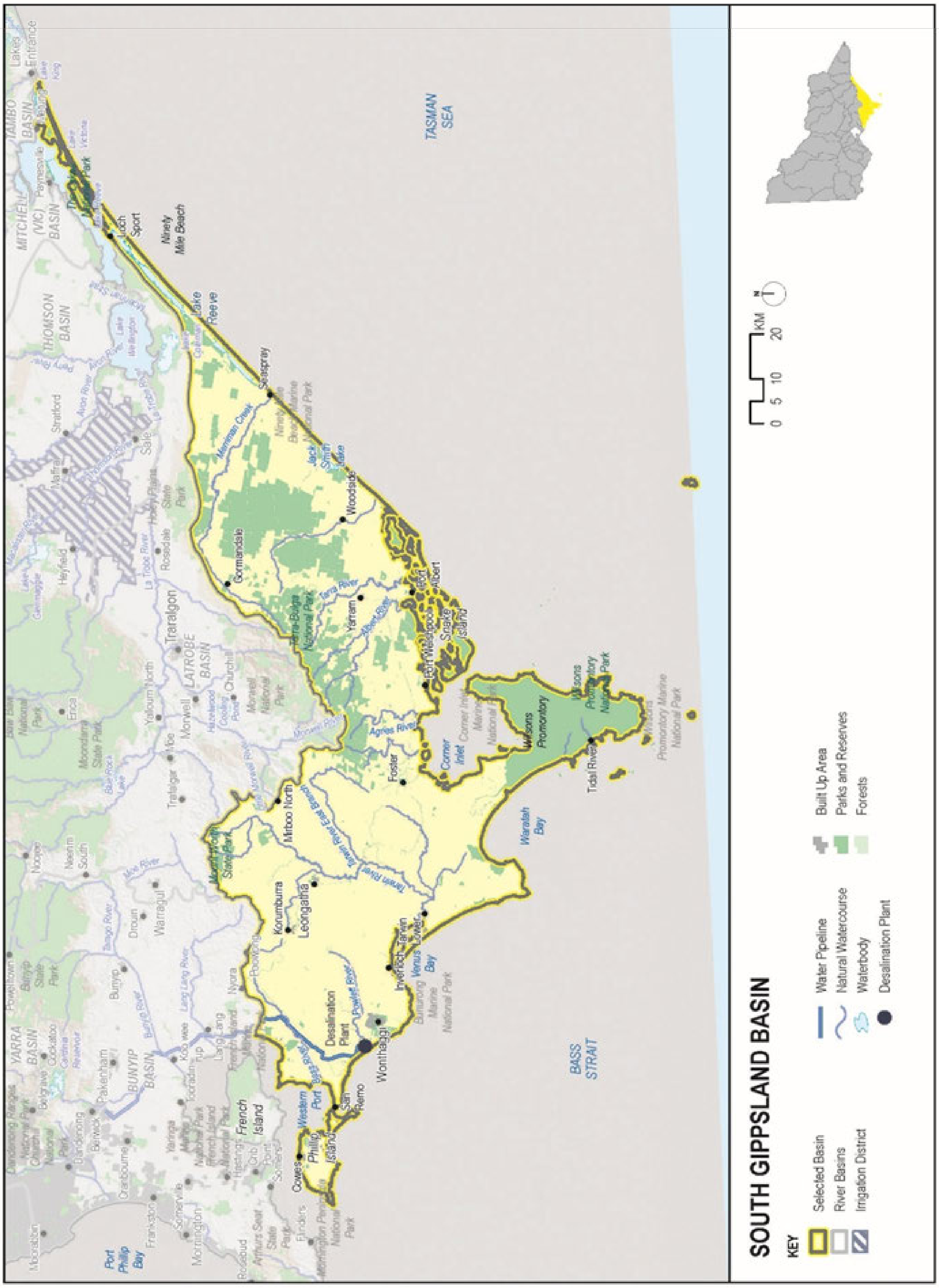
Table 6-88 Volume and use of recycled water in the Latrobe basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled (excludes within plant process)	Type of end use (ML)				Volume discharged to the environment	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Mirboo North	54	54	100%	21	33	0	0	0	0
Moe	1,909	0	0%	0	0	0	0	1,909	0
Morwell	616	616	100%	0	0	616	0	0	0
Dutson Downs (regional outfall sewer)	10,117	90	1%	90	0	0	0	0	10,027
Saline wastewater outfall pipeline	9,278	0	0%	0	0	0	0	0	9,278
Warragul	1,501	0	0%	0	0	0	0	1,501	0
Willow Grove	13	13	100%	0	13	0	0	0	0
Total 2016–17	**23,488**	**773**	**3%**	**111**	**46**	**616**	**0**	**3,410**	**19,305**
Total 2015–16	21,276	690	3%	46	61	583	0	3,450	17,136

6.15 South Gippsland basin

The South Gippsland basin (Figure 6-28) 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 6-28 Map of the South Gippsland basin



6.15.1 Water resources overview

In 2016–17, most of the South Gippsland basin had rainfall between 80% and 100% of the long-term average.

Catchment inflows were 92% of the long-term average of 911,500 ML, an increase when compared to 64% in 2015–16. The amount of water flowing from the South Gippsland basin into Bass Strait and Western Port represented 95% of the total inflows to the basin in 2016–17.

Storage levels in the South Gippsland basin started 2016–17 at 61% of total capacity and ended at 60%.

The licensed diversion bans on Bruthen Creek and on the Albert and Jack rivers in July 2016 were lifted in August. The bans were reinstated on Bruthen Creek in November and continued through summer to be lifted in February 2017. Greigs Creek and Tarra River also had licensed diversion bans in place from December 2016, with the ban on Greigs Creek lifted by April and Tarra River on restrictions in March. Licensed diversions in all streams were unrestricted from April to June 2017.

For urban supplies, stage 1 restrictions were applied to Korumburra by South Gippsland Water between March and June 2017, and they remained in place until 30 June 2017. All other towns in the South Gippsland basin in 2016–17 remained on permanent water-saving rules throughout the year.

Table 6-89 shows the responsibilities of the authorities within the South Gippsland basin.

Table 6-89 Responsibilities for water resources management in the South Gippsland basin

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Southern Rural Water	Manages surface water licensed diversions		
South Gippsland Water		Supplies towns including Leongatha, Inverloch, Wonthaggi, Korumburra and Foster	Obliged to meet passing flow requirements
Westernport Water		Supplies towns including San Remo and Phillip Island	Obliged to meet passing flow requirements
Gippsland Water		Supplies towns in the far east of the basin including Seaspray	Obliged to meet passing flow requirements
West Gippsland Catchment Management Authority			Manages most waterways 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	

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 2016–17, 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.

6.15.2 Surface water resources

6.15.2.1 Water balance

The total volumes of water available and supplied from water resources in the South Gippsland basin in 2016–17 are shown in Table 6-90. Diversions make up a relatively small proportion of total inflows, with about 6% of basin inflows diverted for consumptive use in 2016–17. Most inflows leave the basin and flow into Bass Strait or Western Port.

Table 6-90 Balance of surface water in the South Gippsland basin

Water account component	2016–17 (ML)	2015–16 (ML)
Major on-stream storage		
Volume in storage at start of year	6,398	6,829
Volume in storage at end of year	6,270	6,398
Change in storage	**(128)**	**(431)**
Inflows		
Catchment inflow (1)	835,065	579,308
Rainfall on major storages	1,654	1,336
Treated wastewater discharged back to river	1,229	1,079
Total inflows	**837,948**	**581,723**
Outflows		
Diversions		
Urban diversions	7,906	7,902
Licensed diversions from unregulated streams	2,443	3,889
Small catchment dams	28,387	28,387
Total diversions	***38,736***	***40,178***
Losses		
Evaporation losses from major storages	999	1,626
Evaporation from small catchment dams	7,747	7,747
In-stream infiltration to groundwater, flows to floodplain and evaporation (2)	n/a	n/a
Total losses	***8,745***	***9,373***
Water passed at outlet of basin		
River outflows to Bass Strait and Western Port	790,595	532,603
Total water passed at outlet of basin	***790,595***	***532,603***
Total outflows	**838,076**	**582,154**

Notes

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

(2) No suitable model is available to make an estimate of in-stream losses.

6.15.2.2 Storages and flows

Storage levels for all major storages in the basin were 6,270 ML (60% of capacity) by the end of June 2017, compared to 6,398 ML (61% of capacity) in July 2016 (Table 6-91).

Table 6-91 shows detailed information for storages in the South Gippsland basin. The volume reported in the 'Catchment inflows less regulated releases' column in Table 6-91 is the balancing item for each storage. It represents the flows of water in or out of the storage that are not shown as rainfall or evaporation, and may include other minor components influencing the change in storage during the year.

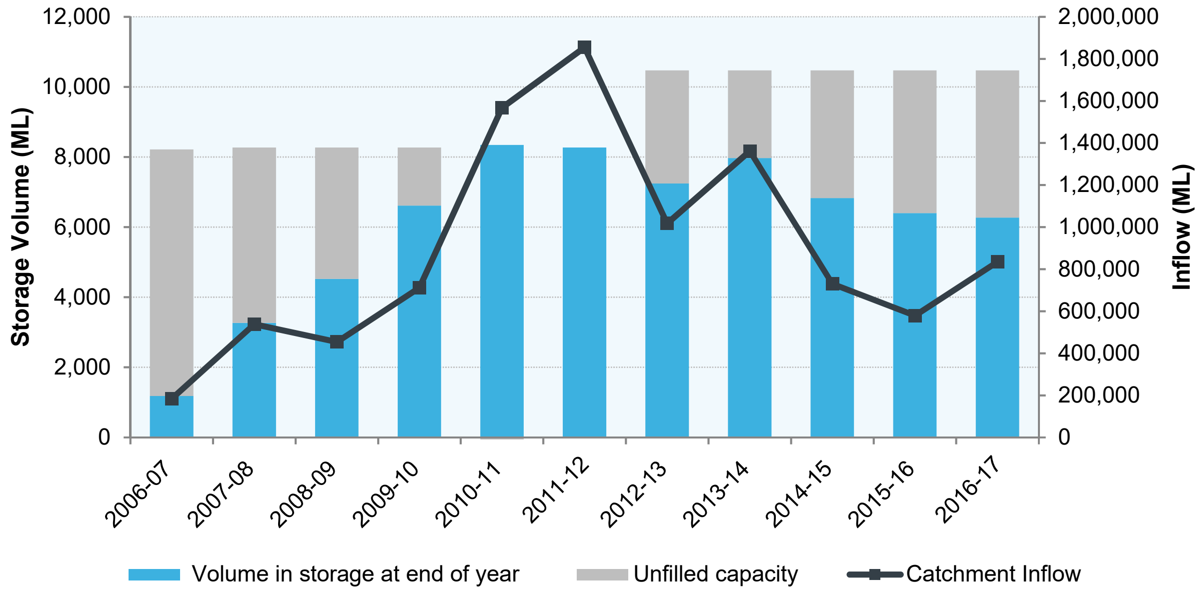
Table 6-91 Storage volumes in the South Gippsland basin

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	2,229	668	746	265	2,416
Hyland Reservoir	671	394	85	22	(129)	328
Lance Creek Reservoir	4,200	3,299	739	189	(760)	3,089
Western Reservoir	1,137	476	162	41	(159)	437
Total storage volumes	**10,471**	**6,398**	**1,654**	**999**	**(783)**	**6,270**

Catchment inflows were 835,065 ML, or 92% of the long-term average (of 911,500 ML), an increase from 64% of the average in 2015–16 (Figure 6-29).

The amount of water flowing from the South Gippsland basin into Western Port and Bass Strait was 790,565 ML in 2016–17. This represents 94% of the total inflows into the basin.

Figure 6-29 Storage volumes and catchment inflows in the South Gippsland basin



6.15.2.3 Entitlement volumes and diversions

In the South Gippsland basin, surface water is diverted by Gippsland Water, South Gippsland Water and Westernport Water. Surface water is also diverted by licensed diverters and harvested in small catchment dams

Entitlements include rights granted to individuals (take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations or the VEWH). Rights to water in the South Gippsland basin are outlined in Table 6-92.

Table 6-92 Entitlement volumes in the South Gippsland basin

Water entitlements	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	12,813
Total volume of water entitlements in the South Gippsland basin	**31,700**

Allocation available under bulk entitlements and licences for 2016–17 is presented in Table 6-93. As in previous years, the volume of water diverted from unregulated streams by take and use licence holders in the South Gippsland basin remains significantly lower than the total licence volume.

Table 6-93 Allocation account balance summary for the South Gippsland basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Devon North Alberton-Yarram and Port Albert	853	0	459	394
Dumbalk	100	0	20	80
Fish Creek	251	0	120	131
Foster	326	0	170	156
Korumburra	1,000	0	877	123
Leongatha	2,476	0	1,715	761
Loch, Poowong and Nyora	420	0	230	190

Meeniyan	200	0	60	140
Seaspray	133	0	34	99
Toora Port Franklin-Welshpool and Port Welshpool	1,617	0	511	1,106
Westernport	2,911	0	2,054	857
Westernport-Bass River	3,000	0	129	2,871
Wonthaggi-Inverloch	5,600	0	1,527	4,073
Take and use licences - unregulated surface water	12,824	(3)	2,443	10,378
Total 2016–17	**31,711**	**(3)**	**10,349**	**21,359**
Total 2015–16	29,911	0	11,791	18,119

The estimated volume of water harvested from small catchment dams represents the largest diversion of water in the South Gippsland basin (Table 6-94). The capacity of small catchment dams for South Gippsland basin is estimated based on GIS mapping. The GIS data used to derive the capacity values for small catchment dams was updated in 2015–16, to provide a more-accurate measure.

Table 6-94 Estimated small catchment dam information for the South Gippsland basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	32,447	16,224	n/a
Registered commercial and irrigation	14,480	12,163	n/a
Total	**46,927**	**28,387**	**36,134**

n/a Information not available.

6.15.3 Recycled water

South Gippsland Water, Westernport Water and Gippsland Water operate treatment plants within the South Gippsland basin. Recycling opportunities within the basin are limited, due to a small industrial base and crop types that are not suited to recycled water.

About 8% of wastewater was recycled in 2016–17, a slight decrease from 11% in 2015–16. 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 6-95 shows the volumes and uses of recycled water in the South Gippsland basin in 2016–17. Where water has been recycled within the plant process, this volume has not been included in the percent recycled value.

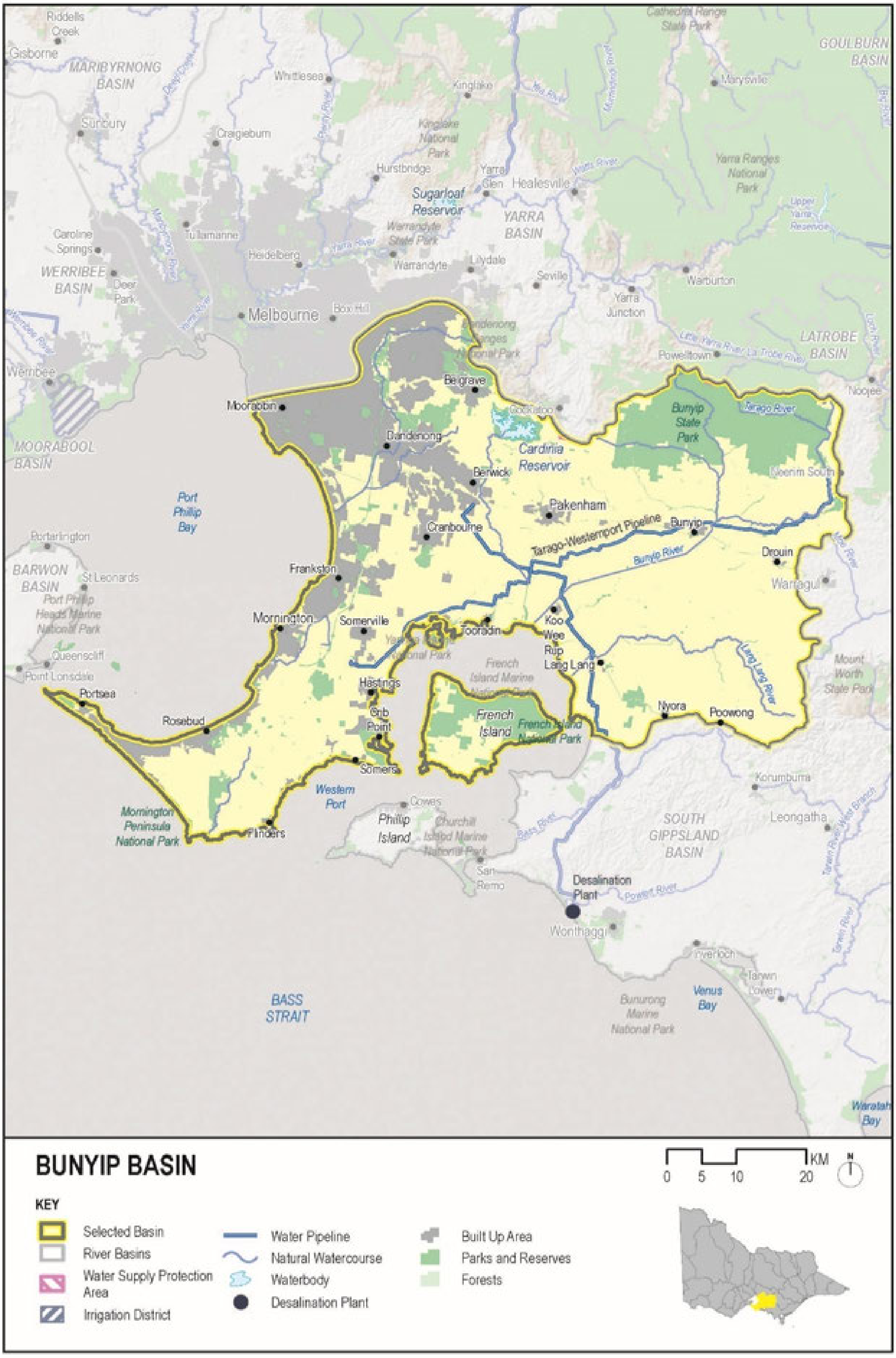
Table 6-95 Volume and use of recycled water in the South Gippsland basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled (excludes within plant process)	Type of end use (ML)				Volume discharged to the environment	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Coronet Bay	203	161	79%	0	161	0	0	0	43
Cowes	1,256	127	9%	66	49	0	12	0	1,129
Foster	142	0	0%	0	0	0	0	0	142
Korumburra	614	0	0%	0	0	0	0	614	0
Leongatha Domestic	595	0	0%	0	0	0	0	595	0
Leongatha Trade Waste	972	0	0%	0	0	0	0	0	972
Meeniyan	25	5	20%	3	2	0	0	20	0
Seaspray	19	19	100%	0	19	0	0	0	0
Toora	29	2	7%	2	0	0	0	0	27
Waratah Bay	9	9	100%	0	9	0	0	0	0
Welshpool	56	0	0%	0	0	0	0	0	56
Wonthaggi / Cape Paterson / Inverloch	1,311	0	0%	0	0	0	0	0	1,311
Yarram / Tarraville	120	120	100%	0	120	0	0	0	0
Total 2016–17	**5,351**	**443**	**8%**	**71**	**360**	**0**	**12**	**1,229**	**3,680**
Total 2015–16	4,769	521	11%	83	423	0	14	1,079	3,171

6.16 Bunyip basin

The Bunyip basin (Figure 6-30) 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 6-30 Map of the Bunyip basin



6.16.1 Water resources overview

In 2016–17, rainfall in the majority of the basin was between 80% and 100% of the long-term average, with the north-west corner and the southern half of the Mornington Peninsula receiving 100% to 125% of average rainfall.

Catchment inflows to the Bunyip basin in 2016–17 were 115% of the long-term average, compared to 86% in 2015–16. The amount of water flowing from the Bunyip basin into Port Phillip Bay and Western Port represented about 90% of the catchment inflows in the basin.

Storage levels in the Bunyip basin started 2016–17 at 91% of total capacity and ended at 88%.

All unregulated streams remained unrestricted throughout 2016–17 except for the Lang Lang River, which maintained relatively steady flows through until mid-March, when irrigators were placed on some pumping bans.

There were no urban water use restrictions applied in the Bunyip basin in 2016–17, with all towns remaining on permanent water-saving rules throughout the year.

Table 6-96 shows the responsibilities of the authorities within the Bunyip basin.

Table 6-96 Responsibilities for water resources management in the Bunyip basin

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
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 Obliged to meet passing flows Manages waterways
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	Obliged to meet passing flows
Victorian Environmental Water Holder			Holds and manages entitlements for the environment in the basin
Port Phillip and Westernport Catchment Management Authority			Responsible for waterway management in the Bunyip basin

Note
(1) Metropolitan Melbourne is mostly supplied from the Yarra and Thomson basins.

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 function ecologically. There is also a nationally threatened population of dwarf galaxias and Australian grayling in the Tarago and Bunyip systems.

In 2016–17, 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 2016–17, 1,952 ML of environmental water was delivered in-stream in the Bunyip basin.

6.16.2 Surface water resources

6.16.2.1 Water balance

The total volumes of water available and supplied from water resources in the Bunyip basin in 2016–17 are shown in Table 6-97.

Table 6-97 Balance of surface water in the Bunyip basin

Water account component	2016–17 (ML)	2015–16 (ML)
Major on-stream storage		
Volume in storage at start of year	34,303	37,652
Volume in storage at end of year	33,181	34,303
Change in storage	**(1,122)**	**(3,349)**
Inflows		
Catchment inflow (1)	622,285	466,417
Rainfall on major storages	3,200	3,275
Treated wastewater discharged back to river	93	858
Total inflows	**625,578**	**470,550**
Outflows		
Diversions		
Urban diversions	19,374	17,952
Licensed diversions from regulated streams	756	750
Licensed diversions from unregulated streams	4,875	5,545
Small catchment dams	32,837	32,837
Total diversions	***57,842***	***57,084***
Losses		
Evaporation losses from major storages	2,468	2,780
Evaporation from small catchment dams	3,240	3,240
In-stream infiltration to groundwater, flows to floodplain and evaporation	847	832
Total losses	***6,555***	***6,852***
Water passed at outlet of basin		
River outflows to Port Phillip Bay and Westernport Bay	562,303	409,964
Total water passed at outlet of basin	***562,303***	***409,964***
Total outflows	**626,700**	**473,900**

Note

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

6.16.2.2 Storages and flows

The Tarago Reservoir is the only major on-stream storage in the Bunyip basin. It ended the year at 33,181 ML (88%), after starting the year at 91% (Table 6-98). The volume reported in the 'Catchment inflows less regulated releases' column in Table 6-98 is the balancing item for each storage. It represents the flows of water in or out of the storage that are not shown as rainfall or evaporation, and may include other minor components influencing the change in storage during the year. Cardinia Reservoir is an off-channel storage located within the Bunyip basin. It stores water harvested and transferred from the Yarra basin and is therefore not included in the Bunyip basin figures.

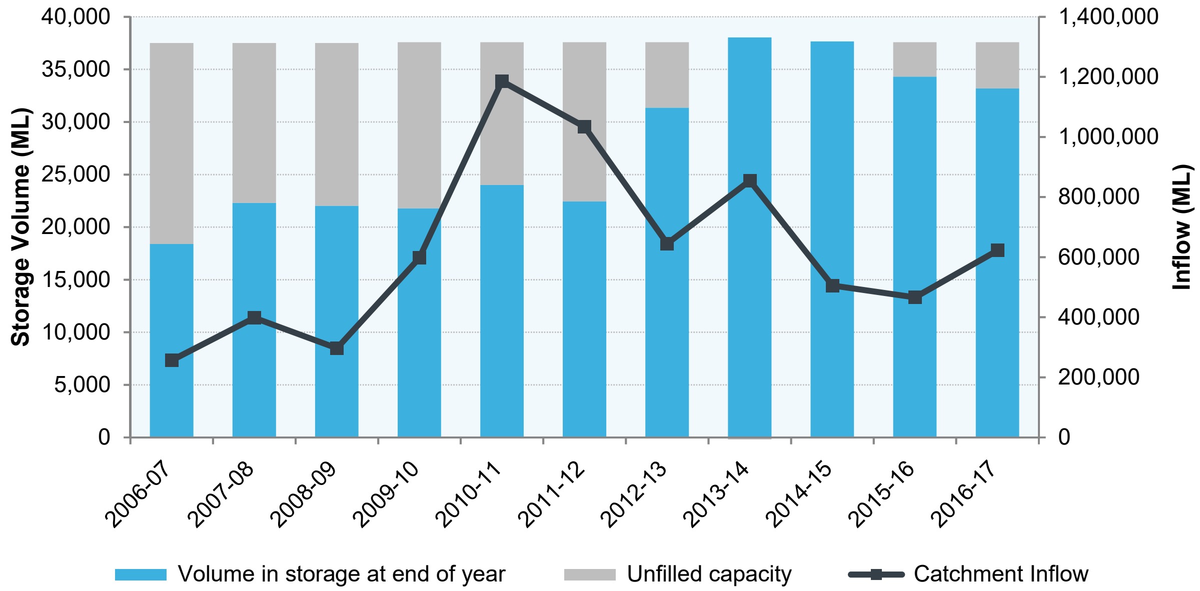
Table 6-98 Storage volumes in the Bunyip basin

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	34,303	3,200	2,468	(1,854)	33,181
Total storage volumes	**37,580**	**34,303**	**3,200**	**2,468**	**(1,854)**	**33,181**

Catchment inflows were 622,285 ML, or 115% of the long-term average of 541,000 ML, an increase from 466,417 ML or 86% of the long-term average in 2015–16 (Figure 6-31).

The amount of water flowing from the Bunyip basin into Port Phillip Bay and Western Port was 562,203 ML in 2016–17, compared to 409,964 ML in 2015–16. This represents 90% of the catchment inflows into the basin for 2016–17.

Figure 6-31 Storage volumes and catchment inflows in the Bunyip basin



6.16.2.3 Entitlement volumes and diversions

Entitlements to water in the Bunyip basin include rights granted to individuals (take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations or environmental entitlements granted to the VEWH). Rights to water in the Bunyip basin are outlined in Table 6-99.

Southern Rural Water, Gippsland Water and Melbourne Water all hold bulk entitlements in the Bunyip basin. Surface water is also diverted by licensed diverters and is harvested in small catchment dams. 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.

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 6-107 and Table 6-105).

Table 6-99 Entitlement volumes in the Bunyip basin

Water entitlements	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	18,896
Total volume of water entitlements in the Bunyip basin	**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 Specified volume is not applicable.

Allocation available under bulk entitlements and licences for 2016–17 is presented in Table 6-100. The volume of water diverted from unregulated streams by licence holders in the Bunyip basin in 2016–17 was lower than the amount (5,544.8 ML) reported in the *Victorian Water Accounts 2015–16* (Table 6-100).

Table 6-100 Allocation account balance summary for the Bunyip basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Tarago River - Gippsland Water	4,825	0	3,750	1,075
Tarago River - Southern Rural Water (1)	1,260	0	756	504
Tarago River - Melbourne Water	30,510	0	15,624	14,886
Tarago and Bunyip Rivers Environmental Entitlement (2)	3,602	0	1,952	1,650
Take and use licences - unregulated surface water	18,910	0	4,875	14,035
Total 2016–17	**59,107**	**0**	**26,957**	**32,150**
Total 2015–16	59,343	0	26,364	32,979

Notes
(1) 'Water use' represents the volume of water ordered via regulated release from Tarago Reservoir to supply licensed diverters downstream of Tarago Reservoir.
(2) Allocation represents the share of available water, net spills and opening carryover. Water use reported reflects environmental in-stream use: this amount is not reflected in the water balance in Table 6-97 as it does not reflect an actual diversion from the waterway. Unused water is available to carry over in this system. For details refer to Table 4-4.

The estimated volume of water harvested from small catchment dams represents the largest diversion of water in the Bunyip basin (Table 6-101). The capacity of small catchment dams for Bunyip basin is estimated based on GIS mapping. The GIS data used to derive the capacity values for small catchment dams was updated in 2015–16 to provide a more-accurate measure.

Table 6-101 Estimated small catchment dam information for the Bunyip basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	23,867	11,934	n/a
Registered commercial and irrigation	24,885	20,903	n/a
Total	**48,752**	**32,837**	**36,076**

n/a Information not available.

6.16.3 Recycled water

Gippsland Water, South East Water and Melbourne Water operate wastewater treatment plants within the Bunyip basin. Overall, 11% of wastewater was recycled for off-site purposes in 2016–17, a decrease on the 15% of wastewater recycled for off-site purposes in 2015–16.

The largest treatment plant is the Eastern Treatment Plant operated by Melbourne Water, which recycled 4% of its total wastewater volume of 142,857 ML. The plant's recycled wastewater was mostly used on-site and this volume has not been included in the percentage of water recycled.

Table 6-102 shows the volume and uses of recycled water in the Bunyip basin in 2016–17. Where water has been recycled within the plant process, this volume has not been included in the percent recycled value.

Table 6-102 Volume and use of recycled water in the Bunyip basin

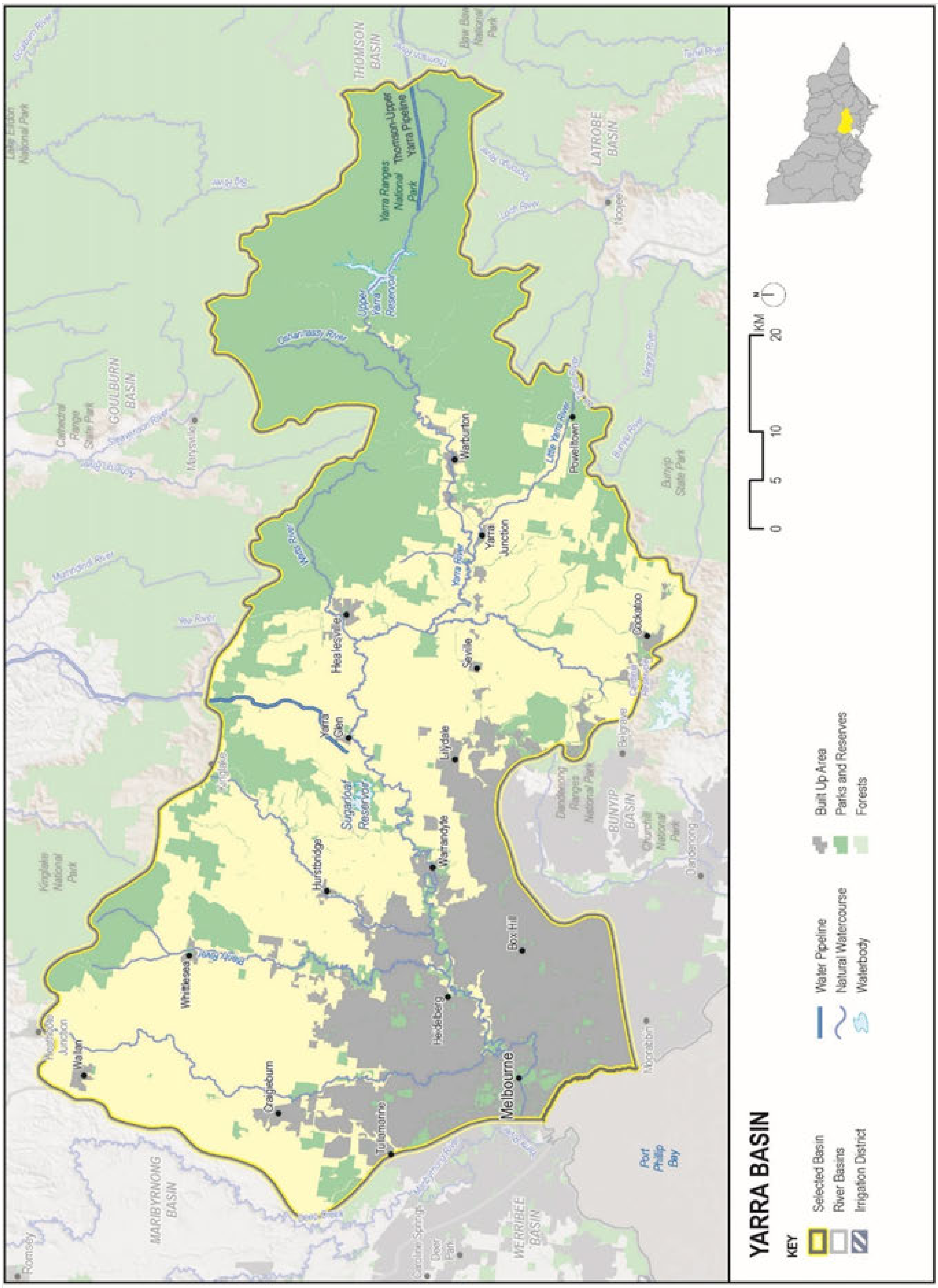
Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled (excludes within plant process)	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial (1)	Agriculture	Beneficial allocation	Within plant process		
Blind Bight	218	218	86%	187	0	0	31	0	0
Boneo	4,321	344	0%	1	0	0	342	0	3,977
Drouin	91	91	100%	0	91	0	0	0	0
Eastern Treatment Plant (1)	142,857	15,257	4%	5,282	0	0	9,975	0	127,600
Kooweerup	239	230	96%	230	0	0	0	0	9
Lang Lang	141	0	0%	0	0	0	0	46	95
Longwarry	282	105	37%	0	105	0	0	0	177
Mt Martha	7,104	758	0%	31	0	0	727	0	6,346
Neerim South	47	0	0%	0	0	0	0	47	0
Pakenham	1,276	730	52%	372	294	0	64	0	546
Somers	1,858	441	19%	316	29	0	96	0	1,417
Total 2016–17	**158,434**	**18,174**	**11%**	**6,419**	**519**	**0**	**11,235**	**93**	**140,167**
Total 2015–16	145,687	21,214	15%	2,466	837	0	10,289	858	123,616

Note
(1) In 2016–17, 5,177 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 2015–16 7,623 ML was diverted to the retailers.

6.17 Yarra basin

The Yarra basin (Figure 6-32) 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 6-32 Map of the Yarra basin



6.17.1 Water resources overview

In 2016–17, rainfall within most of the Yarra basin was between 80% and 100% of the long-term average, with a section to the west receiving between 100% and 125% of the long-term average rainfall.

Catchment inflows were 71% of the long-term average. This was an increase from the previous year's inflows of 46%.

Major storages in the Yarra basin started the year at 63% of capacity and were at 64% at the end of June 2017.

Similar to the previous year, a licensed diversion ban was in place on Pauls and Dixon creeks for most of 2016–17, with a short break in September. Steels Creek fared slightly better this year, with a licensed diversion ban applied in November and a short break in April 2017. Use was restricted again in 2016–17 for licensed diversions in the Yarra basin over the summer months. At the peak, 17 streams were subject to pumping restrictions in February 2017.

No urban water use restrictions were applied in the Yarra basin in 2016–17, with all towns remaining on permanent water-saving rules throughout the year.

The first order for water from the Victorian Desalination Project was made in March 2016 by the Minister for Water. The total volume for 2016–17 delivered to 30 June 2017 was 46,143 ML. This volume represents 2.55% of Melbourne's storage capacity.

Table 6-103 shows the responsibilities of the authorities within the Yarra basin.

Table 6-103 Responsibilities for water resources management in the Yarra basin

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
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) Obliged to meet passing flow requirements
Yarra Valley Water		Supplies the north 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 this basin, using water sources from outside the basin	Obliged to meet passing flow requirements
Victorian Environmental Water Holder			Holds and manages entitlements for the environment in the basin
Port Phillip and Westernport Catchment Management Authority			Responsible for waterway 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.

Water for the environment

Important environmental assets (such as the Australian grayling, river blackfish, Macquarie perch and numerous billabongs and wetlands) depend on water the Yarra. Other assets include:

- the Yarra River between Warburton and Warrandyte 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 2016–17, 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 consumptive bulk entitlements held by the Melbourne retailers
- 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 2016–17, a total of 21,544 ML of environmental water was delivered in-stream in the Yarra basin.

Melbourne headworks system: Greater Yarra system – Thomson River Pool

Melbourne's water has traditionally been sourced from the Yarra, Thomson, Bunyip, Tarago basins and the Goulburn (Silver and Wallaby creeks) basin. Since the Millennium Drought, major investment in infrastructure has brought other water sources on-line 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 a seasonal determination at the beginning of each month to distribute the available water to entitlement holders according to their entitlement share. In 2016–17, seasonal determinations reached 82.6%.

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 (Table 6-110), 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. However, an approved methodology for calculating the variable cap, as at 2016–17, was not yet approved by the Minister for Water.

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 2016–17, 46,143 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 the part of the Melbourne Headworks system in the Yarra basin. This can be seen in Table 6-107 below.

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 - Desalination water	**150,000**

6.17.2 Surface water resources

6.17.2.1 Water balance

The total volumes of water available and supplied from water resources in the Yarra basin in 2016–17 are shown in Table 6-107. Only volumes for major on-stream storages have been included in the water balance. Major off-stream storages (such as Cardinia, Sugarloaf, Greenvale and Silvan reservoirs) have not been included.

Table 6-107 Balance of surface water in the Yarra basin

Water account component	2016–17 (ML)	2015–16 (ML)
Major on-stream storage		
Volume in storage at start of year	138,935	141,842
Volume in storage at end of year	134,833	138,935
Change in storage	**(4,102)**	**(2,907)**
Inflows		
Catchment inflow (1) (3)	751,382	487,615
Rainfall on major storages	11,359	9,085
Transfers from Thomson	86,383	247,098
Inflow of desalinated water	46,143	0
Transfers from Goulburn (Silver and Wallaby Creeks)	3,058	1,059
Transfers from Goulburn via North-South Pipeline (2)	18	0
Treated wastewater discharged back to river (3)	8,444	8,106
Total inflows	**906,787**	**752,962**
Outflows		
Diversions		
Urban diversions	402,031	439,489
Licensed diversions from unregulated streams	6,200	8,356
Small catchment dams	17,346	17,346
Total diversions	***425,577***	***465,191***
Losses		
Evaporation losses from major storages	10,730	11,510
Evaporation from small catchment dams	3,439	3,439
In-stream infiltration to groundwater, flows to floodplain and evaporation (4)	n/a	n/a
Total losses	***14,169***	***14,949***
Water passed at outlet of basin		
River outflows to Port Phillip Bay	471,143	275,730
Total water passed at outlet of basin	***471,143***	***275,730***
Total outflows	**910,889**	**755,869**

Notes

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

(2) 17.5 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 fire-fighting purposes.

(3) The 2015–16 treated wastewater discharged back to river was incorrectly published in the Victorian Water Accounts 2015–16 as 0 ML. This affected the balancing figure (Catchment Inflow) for 2015–16 - which was published as 495,720 ML.

(4) No suitable model is available to make an estimate of in-stream losses.

6.17.2.2 Storages and flows

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.

Storage levels for all major storages in the basin were 448,995ML (64% of capacity) by the end of June 2017, compared to 443,786 ML at the start of July 2016 (Table 6-108). The volume reported in the 'Catchment inflows less regulated releases' column in Table 6-108 is the balancing item for each storage. It represents the flows of water in or out of the storage that are not shown as rainfall or evaporation, and may include other minor components influencing the change in storage during the year.

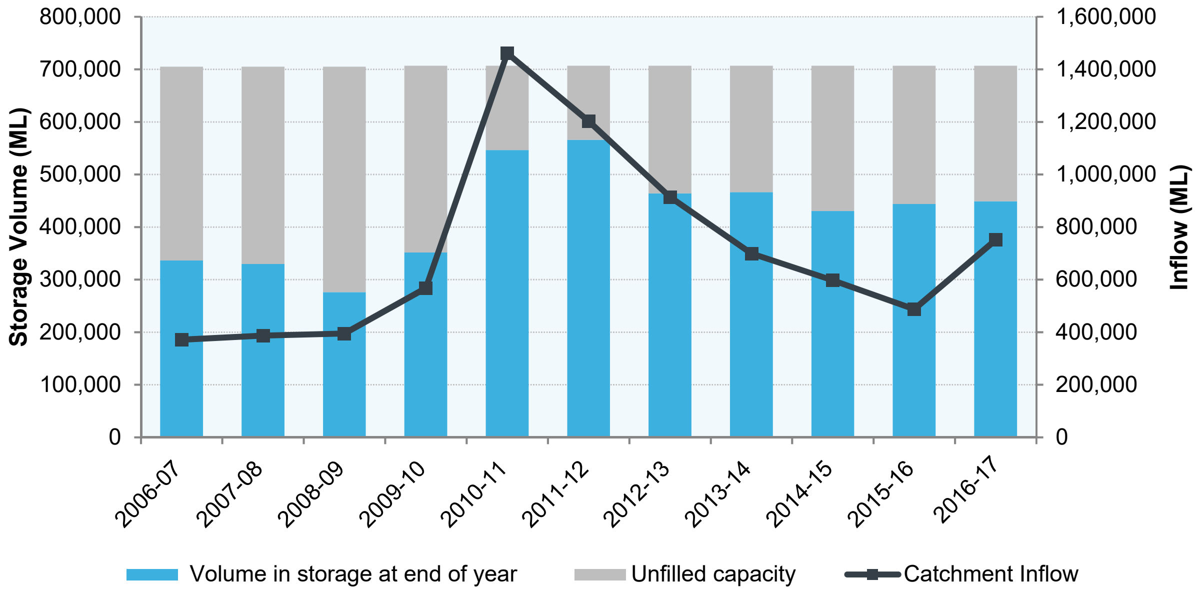
Table 6-108 Storage volumes in the Yarra basin

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	10,832	1,703	1,563	(2,375)	8,597
O'Shannassy Reservoir	3,123	2,323	367	229	80	2,541
Upper Yarra Reservoir	200,579	101,567	5,326	4,528	(5,122)	97,243
Yan Yean Reservoir	30,266	24,213	3,963	4,410	2,686	26,452
Total on-stream storages	**256,147**	**138,935**	**11,359**	**10,730**	**(4,731)**	**134,833**
Off-stream storages						
Cardinia Reservoir	286,911	181,593	9,721	7,916	5,957	189,355
Greenvale Reservoir	26,839	21,492	1,212	1,978	1,906	22,632
Silvan Reservoir	40,445	35,962	3,380	2,477	(1,708)	35,157
Sugarloaf Reservoir	96,253	65,804	3,085	3,832	1,961	67,018
Total off-stream storages	**450,448**	**304,851**	**17,398**	**16,203**	**8,116**	**314,162**
Total storage volumes	**706,595**	**443,786**	**28,757**	**26,933**	**3,385**	**448,995**

Catchment inflows to the Yarra basin in 2016–17 were 751,311 ML, or 71% of the long-term average (of 1,054,000 ML). This is much higher than 2015–16, when catchment inflows were 487,615 ML or 46% of the long-term average (Figure 6-33).

The amount of water flowing from the Yarra basin into Port Phillip Bay was 471,143 ML in 2016–17. This represents 63% of the catchment inflows to the basin, compared to 56% in 2015–16.

Figure 6-33 Storage volumes and catchment inflows in the Yarra basin



6.17.2.3 Entitlement volumes and diversions

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). Entitlements in the Yarra basin include rights granted to authorities and individual (bulk entitlements, take and use licences, and rights granted to the VEWH for environmental entitlements). Rights to water in the Yarra basin are outlined in Table 6-109.

Table 6-109 Entitlement volumes in the Yarra basin

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (Yarra River - Melbourne Water) 2014	400,000
Bulk Entitlement (Yarra Environment Entitlement) 2006	
High Reliability	17,000
Unregulated surface water	55
Sub-total: Bulk Entitlement (Yarra Environment Entitlement) 2006	**17,055**
Take and use licences - unregulated surface water	42,773
Total volume of water entitlements in the Yarra basin	**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 methodology as stated in its bulk entitlements. However, an approved methodology for calculating the variable cap, as at 2016–17, was not yet approved by the Minister for Water. 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.

Allocation available under bulk entitlements and licences for 2016–17 is presented in Table 6-110. The VEWH holds an environmental entitlement in the Yarra basin. Water available under the entitlement is not diverted out of the waterway. It has therefore not been included as part of the water balance diversions in Table 6-107.

Table 6-110 Allocation account balance summary for the Yarra basin

Water entitlement	Allocation issued (ML)	Net trade In / (Out) (ML)	Water use (ML)	End of season forfeitures (ML)
Yarra River - Melbourne Water [1]	400,000	0	302,147	97,853
Yarra Environment Entitlement [2]	41,278	0	21,544	19,734
Take and use licences - unregulated surface water	42,795	(25)	6,200	36,570
Total 2016-17	**484,073**	**(25)**	**329,891**	**154,157**
Total 2015–16	477,858	(1,995)	208,505	267,358

Notes

(1) 302,147 ML was used to supply entitlement holders that have bulk entitlements for the Greater Yarra system – Thomson River Pool.

(2) The VEWH has access to carryover so 'Allocation issued' includes both the 17,000 ML issued this year plus carryover of 24,278 ML from 2015–16. 'Water use' under the Yarra Environment Entitlement reflects environmental in-stream use. This amount is not included in the water balance in Table 6-107 as it is not an actual diversion from the waterway. The VEWH does not forfeit the water at the end of the season. Any unused water is carried over to the next year (see also Table 4-4).

The estimated volume of water harvested from small catchment dams in the Yarra basin is shown in Table 6-111. The capacity of small catchment dams for Yarra basin is estimated based on GIS mapping. The GIS data used to derive the capacity values for small catchment dams was updated in 2015–16, to provide a more-accurate measure.

Table 6-111 Estimated small catchment dam information for the Yarra basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	18,375	9,188	n/a
Registered commercial and irrigation	9,712	8,158	n/a
Total	**28,087**	**17,346**	**20,784**

n/a Information not available.

6.17.3 Recycled water

Yarra Valley Water operate all treatment plants within the Yarra basin. Overall, 10% of wastewater was recycled in 2016–17, similar to the previous year when 12% was recycled.

Table 6-112 shows the volumes and uses of recycled water in the Yarra basin in 2016–17. Where water has been recycled within the plant process, this volume has not been included in the percent recycled value.

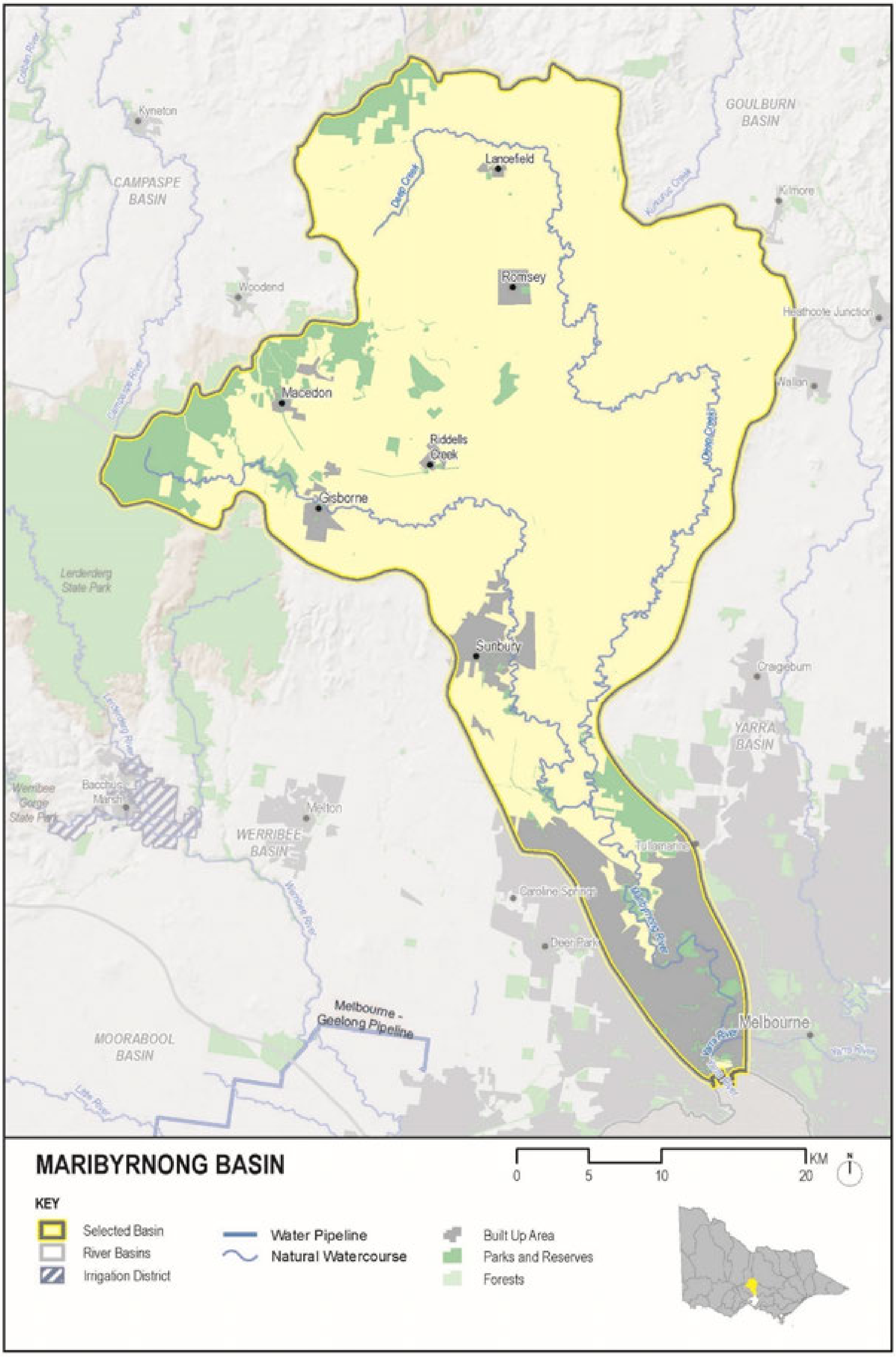
Table 6-112 Volume and use of recycled water in the Yarra basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled (excludes within plant process)	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	1,477	301	10%	0	143	0	158	0	1,176
Brushy Creek	4,572	646	0%	23	0	0	624	3,926	0
Craigieburn	1,233	530	6%	69	0	0	461	703	0
Healesville	457	84	0%	0	0	0	84	373	0
Lilydale	3,028	830	3%	106	0	0	724	2,198	0
Monbulk	22	0	0%	0	0	0	0	22	0
Upper Yarra	903	132	0%	0	0	0	132	771	0
Wallan	958	903	94%	49	854	0	0	281	(225)
Whittlesea	337	126	29%	50	47	0	29	170	41
Total 2016–17	**12,987**	**3,552**	**10%**	**297**	**1,044**	**0**	**2,212**	**8,444**	**992**
Total 2015–16	12,875	3,906	12%	786	747	0	2,373	8,106	863

6.18 Maribyrnong basin

The Maribyrnong basin (Figure 6-34) 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 6-34 Map of the Maribyrnong basin



6.18.1 Water resources overview

Rainfall across the Maribyrnong basin in 2016–17 was between 100% and 125% of the long-term average.

Catchment inflows were 121% of the long-term average of 113,000 ML, much higher than the inflows recorded in 2015–16 which saw inflows at 18% of the long-term average.

The storage volume in Rosslynne Reservoir started the year at 15% of capacity; it was 38% of capacity at the end of June 2017.

A licensed diversion ban was in place on the Maribyrnong River for surface water users with winter-fill licences from November 2016 to June 2017. Unlike the previous year where 13 streams had total diversion bans in place from December 2015 through to June 2016, only Riddles, Turitable and Willimigongon creeks had bans in place in February 2017. The ban on Riddles Creek continued from March to June 2017 with the bans lifted on Turitable and Willimigongon creeks from March.

No urban water use restrictions applied in the Maribyrnong basin in 2016–17, with all towns remaining on permanent water-saving rules throughout the year.

Table 6-113 shows the responsibilities of the authorities within the Maribyrnong basin.

Table 6-113 Responsibilities for water resources management in the Maribyrnong basin

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
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 Greater Yarra system – Thomson River Pool)	Manages waterways, drainage and floodplains in part of the Maribyrnong basin
City West Water		Supplies part of metropolitan Melbourne (1)	
Western Water		Supplies towns in the basin outside metropolitan Melbourne	Operates Macedon reservoirs Obliged to meet passing flow requirements
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 Obliged to meet passing flow requirements
Port Phillip and Westernport Catchment Management Authority			Responsible for waterway management in the Maribyrnong basin

Note

(1) Melbourne is mostly supplied from the Yarra and Thomson basins.

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 2016–17, 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)
- 304 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 2016–17, a total of 304 ML of environmental water was used in the Maribyrnong basin.

6.18.2 Surface water resources

6.18.2.1 Water balance

The total volumes of water available and supplied from water resources in the Maribyrnong basin in 2016–17 are shown in Table 6-114.

Table 6-114 Balance of surface water in the Maribyrnong basin

Water account component	2016–17 (ML)	2015–16 (ML)
Major on-stream storage		
Volume in storage at start of year	3,732	11,176
Volume in storage at end of year	9,526	3,732
Change in storage	**5,794**	**(7,444)**
Inflows		
Catchment inflow (1)	136,619	19,806
Rainfall on major storages	816	535
Treated wastewater discharged back to river	2,633	1,597
Total inflows	**140,068**	**21,938**
Outflows		
Diversions		
Urban diversions	2,282	5,854
Licensed diversions from regulated streams	479	399
Licensed diversions from unregulated streams	321	288
Small catchment dams	6,876	6,876
Total diversions	***9,959***	***13,417***
Losses		
Evaporation losses from major storages	1,032	773
Evaporation from small catchment dams	6,678	6,678
In-stream infiltration to groundwater, flows to floodplain and evaporation	2,576	2,656
Total losses	***10,286***	***10,107***
Water passed at outlet of basin		
River outflows to the Yarra River	114,030	5,858
Total water passed at outlet of basin	***114,030***	***5,858***
Total outflows	**134,274**	**29,383**

Note

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

6.18.2.2 Storages and flows

The Rosslynne Reservoir is the only major on-stream storage in the Maribyrnong basin. The storage volume was 9,526 ML (38% of capacity) at the end of June 2017, compared to 3,732 ML (15% of capacity) at the start of July 2016 (Table 6-115). The volume reported in the 'Catchment inflows less regulated releases' column in Table 6-115 is the balancing item for each storage. It represents the flows of water in or out of the storage that are not shown as rainfall or evaporation, and may include other minor components influencing the change in storage during the year.

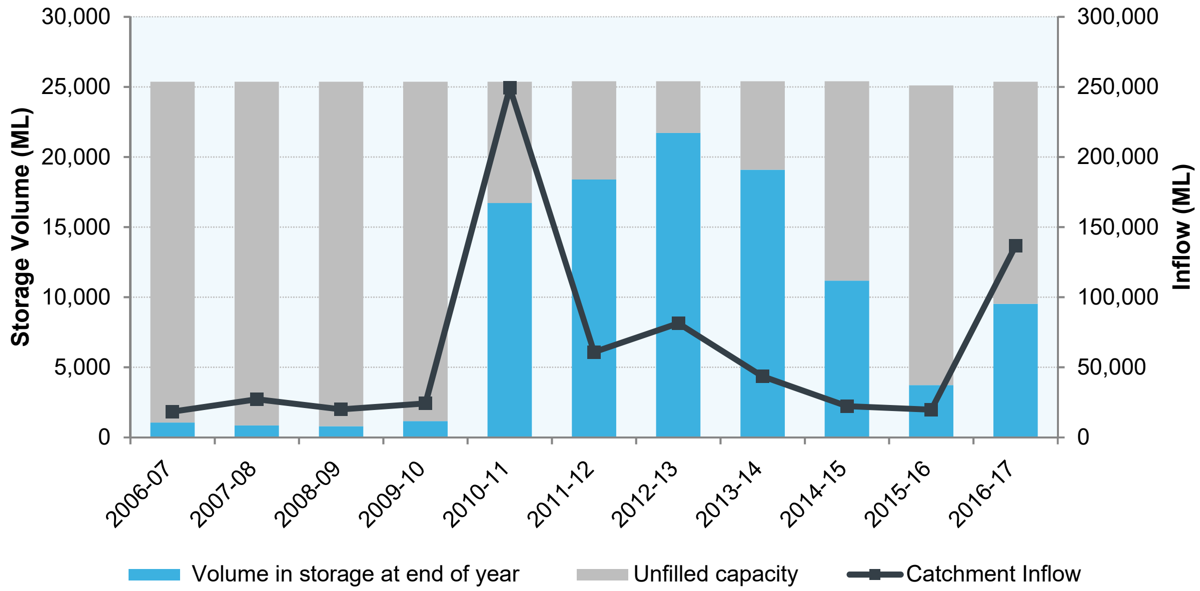
Table 6-115 Storage volumes in the Maribyrnong basin

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	3,732	816	1,032	6,010	9,526
Total storage volumes	**25,368**	**3,732**	**816**	**1,032**	**6,010**	**9,526**

Catchment inflows were 136,619 ML, or 121% of the long-term average of 113,000 ML. This was large increase from 2015–16, when inflows were 19,806 ML or 18% of the long-term average (Figure 6-35).

The amount of water flowing into the Yarra River in 2016–17 was 114,030 ML, compared to 5,858 ML in 2015–16. This represents 83% of the catchment inflows into the basin.

Figure 6-35 Storage volumes and catchment inflows in the Maribyrnong basin



6.18.2.3 Entitlement volumes and diversions

Melbourne Water, Western Water and Southern Rural Water hold bulk entitlements to divert surface water in the Maribyrnong basin. Surface water is also diverted out of waterways by licence holders and harvested in small catchment dams.

Entitlements include rights granted to individuals (take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations). Rights to water in the Maribyrnong basin are outlined in Table 6-116.

Table 6-116 Entitlement volumes in the Maribyrnong basin

Water entitlements	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 volume of water entitlements in the Maribyrnong basin	**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 2016–17 year.
(4) This entitlement supplies water for take and use licences: 214 ML of entitlement was allocated for the 2016–17 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.

Allocation available under bulk entitlements and licences for 2016–17 is presented in Table 6-117. The volume of water diverted from unregulated streams by licence holders in the Maribyrnong basin was higher in 2016–17 (321 ML) than the volume (288 ML) reported in the *Victorian Water Accounts 2015–16* (Table 6-117).

Table 6-117 Allocation account balance summary for the Maribyrnong basin

Water entitlement	Allocation issued (ML)	Net trade In / (Out) (ML)	Water use (ML)	End of season forfeitures (ML)
Gisborne - Barringo Creek	585	0	0	585
Lancefield	315	0	115	200
Macedon and Mount Macedon	873	0	199	674
Maribyrnong - Melbourne Water (1)	1,128	0	467	661

Maribyrnong - Southern Rural Water	214	0	12	202
Maribyrnong - Western Water	6,100	0	1,498	4,602
Riddells Creek	300	0	13	287
Romsey	460	0	457	3
Take and use licences - unregulated surface water	2,061	0	321	1,740
Total 2016–17	**12,036**	**0**	**3,083**	**8,954**
Total 2015–16	12,090	0	6,541	5,549

Note

(1) Use against the Melbourne Water entitlement includes 304 ML of temporary water purchased by VEWH from take and use licence holders to be used to provide environmental releases in the Maribyrnong system.

The estimated volume of water harvested from small catchment dams represents the largest diversion of water in the Maribyrnong basin (Table 6-118). The capacity of small catchment dams for Maribyrnong basin is estimated based on GIS mapping. The GIS data used to derive the capacity values for small catchment dams was updated in 2015–16, to provide a more-accurate measure.

Table 6-118 Estimated small catchment dam information for the Maribyrnong basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	10,499	5,250	n/a
Registered commercial and irrigation	1,936	1,626	n/a
Total	**12,435**	**6,876**	**13,554**

n/a Information not available.

6.18.3 Recycled water

All wastewater treatment plants within the basin are operated by Western Water. About 14% of wastewater was reused in 2016–17, a decrease from 20% in 2015–16.

Table 6-119 shows the volumes and uses of recycled water in the Maribyrnong basin in 2016–17. Where water has been recycled within the plant process, this volume has not been included in the percent recycled value.

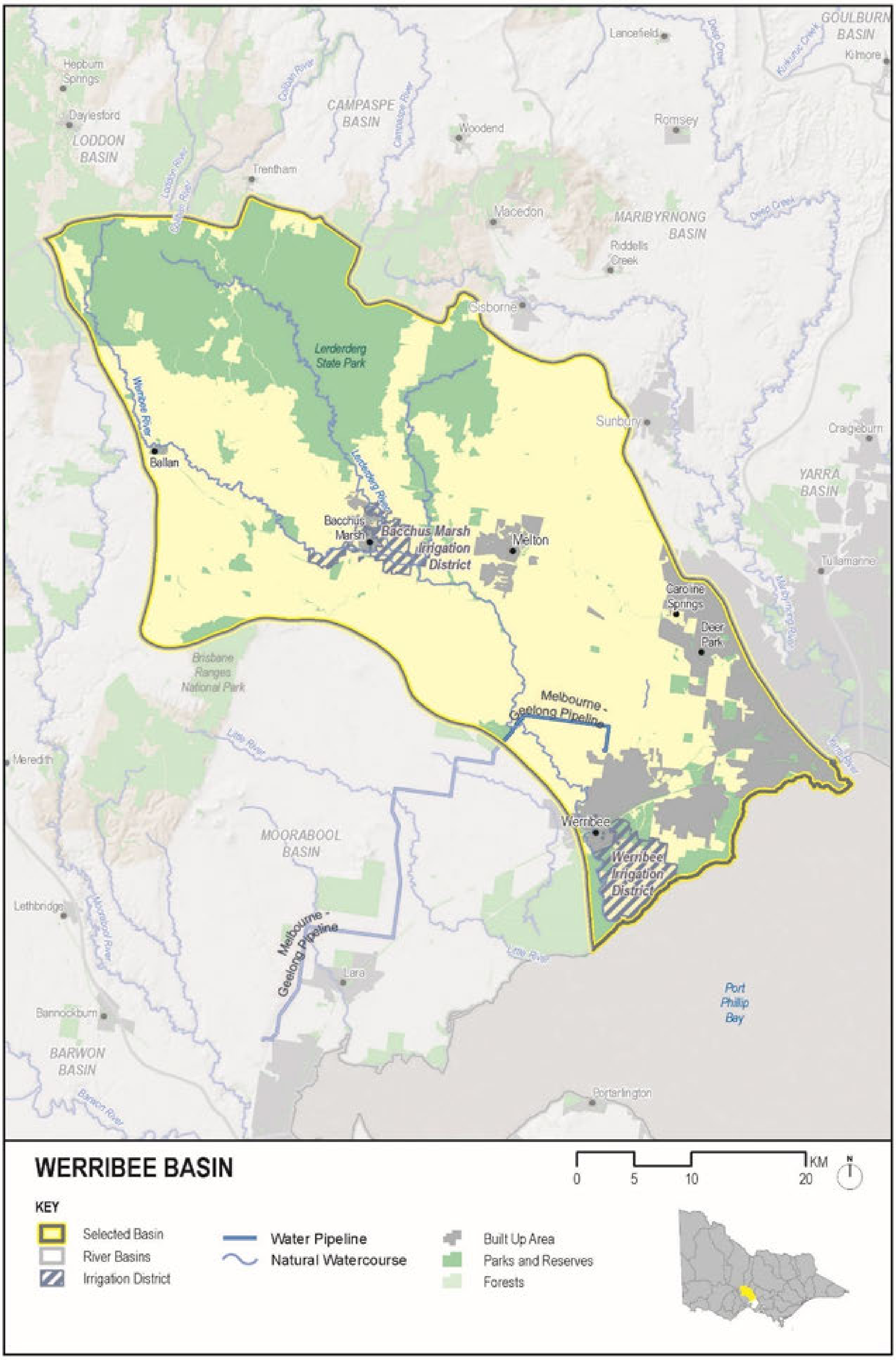
Table 6-119 Volume and use of recycled water in the Maribyrnong basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled (excludes within plant process)	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	1,053	356	6%	50	9	0	297	697	0
Riddells Creek	121	44	36%	8	36	0	0	77	0
Romsey	438	301	69%	23	278	0	0	137	0
Sunbury	5,434	3,712	10%	309	253	0	3,150	1,722	0
Total 2016–17	**7,046**	**4,413**	**14%**	**390**	**576**	**0**	**3,447**	**2,633**	**0**
Total 2015–16	5,671	4,073	20%	513	631	0	2,929	1,597	0

6.19 Werribee basin

The Werribee basin (Figure 6-36) 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 6-36 Map of the Werribee basin



6.19.1 Water resources overview

Rainfall across the Werribee basin in 2016–17 was between 100% and 125% of the long-term average.

Catchment inflows were 126% of the long-term average, much higher than in 2015–16 when inflows were 21% of the long-term average. The amount of water flowing from the Werribee basin into Port Phillip Bay represented 49% of the catchment flows into the basin in 2016–17.

Major storages in the Werribee basin started the year at 15% of capacity, compared to 61% by the end of June 2017.

The Lerderderg River system fared slightly better in 2016–17, compared to previous years. However, low rainfall still contributed to restrictions in February, which remained in place until 30 June 2017. Licensed diversions from Cockatoo and Shephard Creek were also restricted during the second half of 2016–17, with a total ban in January and restrictions from February to June 2017 (with a reprieve in April 2017 when the creek remained unrestricted).

No urban water use restrictions applied in the Werribee basin in 2016–17, with all towns remaining on permanent water-saving rules throughout the year.

Table 6-120 shows the responsibilities of the authorities within the Werribee basin.

Table 6-120 Responsibilities for water resources management in the Werribee basin

Authority	Irrigation & rural water supply	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Southern Rural Water	Manages Werribee and Bacchus Marsh irrigation districts	Manages licensed diversions		Operates Pykes Creek Reservoir, Melton Reservoir and Merrimu Reservoir Obliged to meet passing flow requirements
Western Water			Supplies towns in the north of the basin including Melton and Bacchus Marsh	Operates Djerriwarrh Reservoir Obliged to meet passing flow requirements
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	Obliged to meet passing flow requirements
Victorian Environmental Water Holder				Holds and manages entitlements for the environment in the basin
Port Phillip and Westernport Catchment Management Authority				Responsible for waterway management in the Werribee basin

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 2016–17, 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 2016–17, a total of 2,076 ML of environmental water was delivered in-stream in the Werribee basin. In 2016–17, the water available for this use was supplemented by 896 ML traded into VEWH allocation accounts.

6.19.2 Surface water resources

6.19.2.1 Water balance

The total volumes of water available and supplied from water resources in the Werribee basin in 2016–17 are shown in Table 6-121. Note that only on-stream storages greater than 1,000 ML capacity and the Djerriwarrh Reservoir have been included in the water balance. In the Werribee basin, major storages include the Melton, Merrimu and Pykes Creek reservoirs.

Table 6-121 Balance of surface water in the Werribee basin

Water account component	2016–17 (ML)	2015–16 (ML)
Major on-stream storage		
Volume in storage at start of year	10,341	24,146
Volume in storage at end of year	42,699	10,341
Change in storage	**32,357**	**(13,805)**
Inflows		
Catchment inflow (1)	128,564	21,115
Rainfall on major storages	2,708	1,370
Transfers from other basins	0	0
Return flow from irrigation	61	0
Treated wastewater discharged back to river	411	168
Total inflows	**131,744**	**22,653**
Outflows		
Diversions		
Urban diversions	1,668	3,654
Irrigation district diversions (2)	13,551	10,256
Licensed diversions from regulated streams (2)	221	397
Licensed diversions from unregulated streams	8	12
Small catchment dams	5,484	5,484
Total diversions	***20,933***	***19,802***
Losses		
Evaporation losses from major storages	4,864	2,232
Evaporation from small catchment dams	5,728	5,728
In-stream infiltration to groundwater, flows to floodplain and evaporation	6,857	3,352
Total losses	***17,449***	***11,312***
Water passed at outlet of basin		
River outflows to Port Phillip Bay	61,005	5,344
Total water passed at outlet of basin	***61,005***	***5,344***
Total outflows	**99,387**	**36,458**

Notes

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

(2) Irrigation district diversions and licensed diversions from regulated streams were reported as one line item in the 2015–16 accounts, and the volume was incorrectly reported as 10,602 ML. The 2015–16 volume has been revised from the 2015–16 published report. The revision required a recalculation of catchment inflows, and thus this is also reported differently to the 2015–16 published accounts.

6.19.2.2 Storages and flows

Storage levels for all major storages in the basin were 42,699 ML (61% of capacity) at 30 June 2017, compared to 10,341 ML (15% of capacity) at 1 July 2016 (Table 6-122). The volume reported in the 'Catchment inflows less regulated releases' column in Table 6-122 is the balancing item for each storage. It represents the flows of water in or out of the storage that are not shown as rainfall or evaporation, and may include other minor components influencing the change in storage during the year.

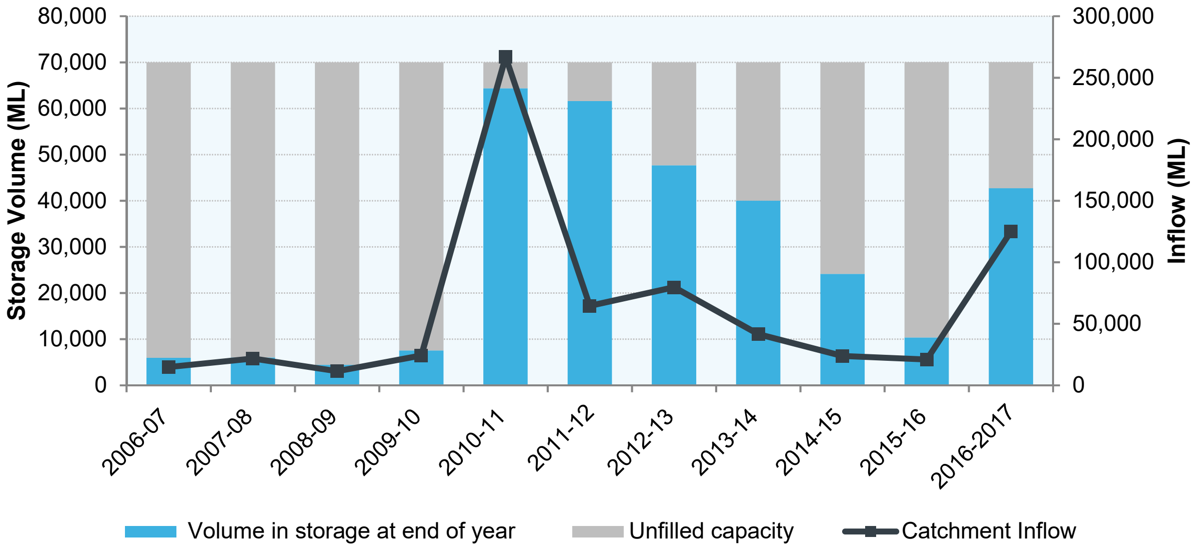
Table 6-122 Storage volumes in the Werribee basin

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	397	85	100	577	959
Melton Reservoir	14,364	950	773	1,549	7,176	7,350
Merrimu Reservoir (total)	32,516	3,100	855	1,630	14,091	16,416
Pykes Creek Reservoir	22,119	5,894	995	1,585	12,670	17,974
Total storage volumes	**70,013**	**10,341**	**2,708**	**4,864**	**34,514**	**42,699**

Catchment inflows were 128,564 ML, or 126% of the long-term average of 102,000 ML. This was higher than the 2015–16 inflows of 21,065 ML (Figure 6-37).

In 2016–17, 61,005 ML of water flowed from the Werribee basin into Port Phillip Bay. This represents 47% of the catchment inflows into the basin. This is compared to 5,344 ML reported in 2015–16.

Figure 6-37 Storage volumes and catchment inflows in the Werribee basin



6.19.2.3 Entitlement volumes and diversions

In the Werribee basin, surface water is diverted by Central Highlands Water, Western Water, Southern Rural Water and licensed diverters, and surface water is harvested in small catchment dams.

Entitlements include rights granted to individuals (for example, water shares and take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations or the VEWH). Rights to water in the Werribee basin are outlined in Table 6-123.

Table 6-123 Entitlement volumes in the Werribee basin

Water entitlements	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
Sub-total: 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	**1,019**
Total volume of water entitlements in the Werribee basin	**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 Specified volume is not applicable.

Allocation available under bulk entitlements and licences for 2016–17 is presented in Table 6-124. 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.

Southern Rural Water diverted 12,485 ML to supply water share holders in the Werribee and Bacchus Marsh irrigation districts in 2016–17 (Table 6-124), compared to 10,653 ML in 2015–16.

Table 6-124 Allocation account balance summary for the Werribee basin

Water entitlement	Opening carryover (ML)	Allocation issued (ML)	Net trade In / (Out) (ML)	Water use (ML)	End of season forfeitures (ML)	Carryover carried forward (ML)
Werribee system - Irrigation - Southern Rural Water						
Water shares (1)	3,461	18,575	0	9,661	1,379	10,997
Myrniong	6	58	0	45	19	0
Operating provision (2)	-	-	-	4,947	-	-
Net diversion: Werribee system - Irrigation - Southern Rural Water (3)				**13,756**		
Ballan	-	451	0	0	451	-
Blackwood and Barry's Reef	-	140	0	54	86	-
Werribee system - Western Water	-	9,986	0	1,569	8,417	-
Werribee River Environment Entitlement (3)	1,399	1,804	0	1,179	0	2,024
Take and use licences - unregulated surface water	-	1,021	0	8	1,013	-
Total 2016–17	**4,866**	**32,035**	**0**	**17,464**	**11,364**	**13,020**
Total 2015–16	6,653	14,076	2,084	14,918	8,530	4,902

Notes

(1) Water use reported includes 896 ML of environmental in-stream use. This water allocation was traded to VEWH for environmental purposes. This amount is not reflected in the water balance in Table 6-120 as it does not reflect an actual diversion from the waterway.
(2) This reflects use of water to manage the system. It includes any loss incurred in supplying the primary entitlements.
(3) 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 flows from irrigation). It does not include water delivered in-stream for environmental purposes.
(4) 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.

The estimated volume of water harvested from small catchment dams represents a significant portion of the total volume of surface water diverted in the Werribee basin (Table 6-125). The capacity of small catchment dams for Werribee basin is estimated based on GIS mapping. The GIS data used to derive the capacity values for small catchment dams was updated in 2015–16, to provide a more-accurate measure.

Table 6-125 Estimated small catchment dam information for the Werribee basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	9,284	4,642	n/a
Registered commercial and irrigation	1,002	842	n/a
Total	**10,286**	**5,484**	**11,212**

6.19.3 Recycled water

City West Water, Central Highlands Water, Western Water and Melbourne Water operate treatment plants within the Werribee basin. About 13% of wastewater was reused in 2016–17, a decrease from 16% in 2015–16.

The largest treatment plant in the basin is Melbourne Water's Western Treatment Plant, which recycled 13% of wastewater in 2016–17. This included 12,387 ML for on-site irrigation and environmental management and 5,602 ML for habitat management at Ramsar-listed wetlands.

Table 6-126 shows the volumes and uses of recycled water in the Werribee basin in 2016–17. Where water has been recycled within the plant process, this volume has not been included in the percent recycled value.

Table 6-126 Volume and use of recycled water in the Werribee basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled (excludes within plant process)	Type of end use (ML)				Volume discharged to the environment	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within process		
Altona	5,444	2,101	38%	2,072	0	0	29	0	3,343
Ballan	123	54	44%	0	54	0	0	69	0
Melton	4,409	4,067	83%	448	3,230	0	388	342	0
Parwan (Bacchus Marsh)	273	273	100%	41	233	0	0	0	0
Sunshine Golf Course Sewer Mining Plant	31	31	100%	31	0	0	0	0	0
Western Treatment Plant (1)	184,470	23,589	13%	5,551	12,387	5,602	49	0	160,881
Total 2016–17	**194,750**	**30,115**	**13%**	**8,143**	**15,904**	**5,602**	**466**	**411**	**164,224**
Total 2015–16	177,167	32,939	16%	2,685	19,363	3,870	799	168	144,060

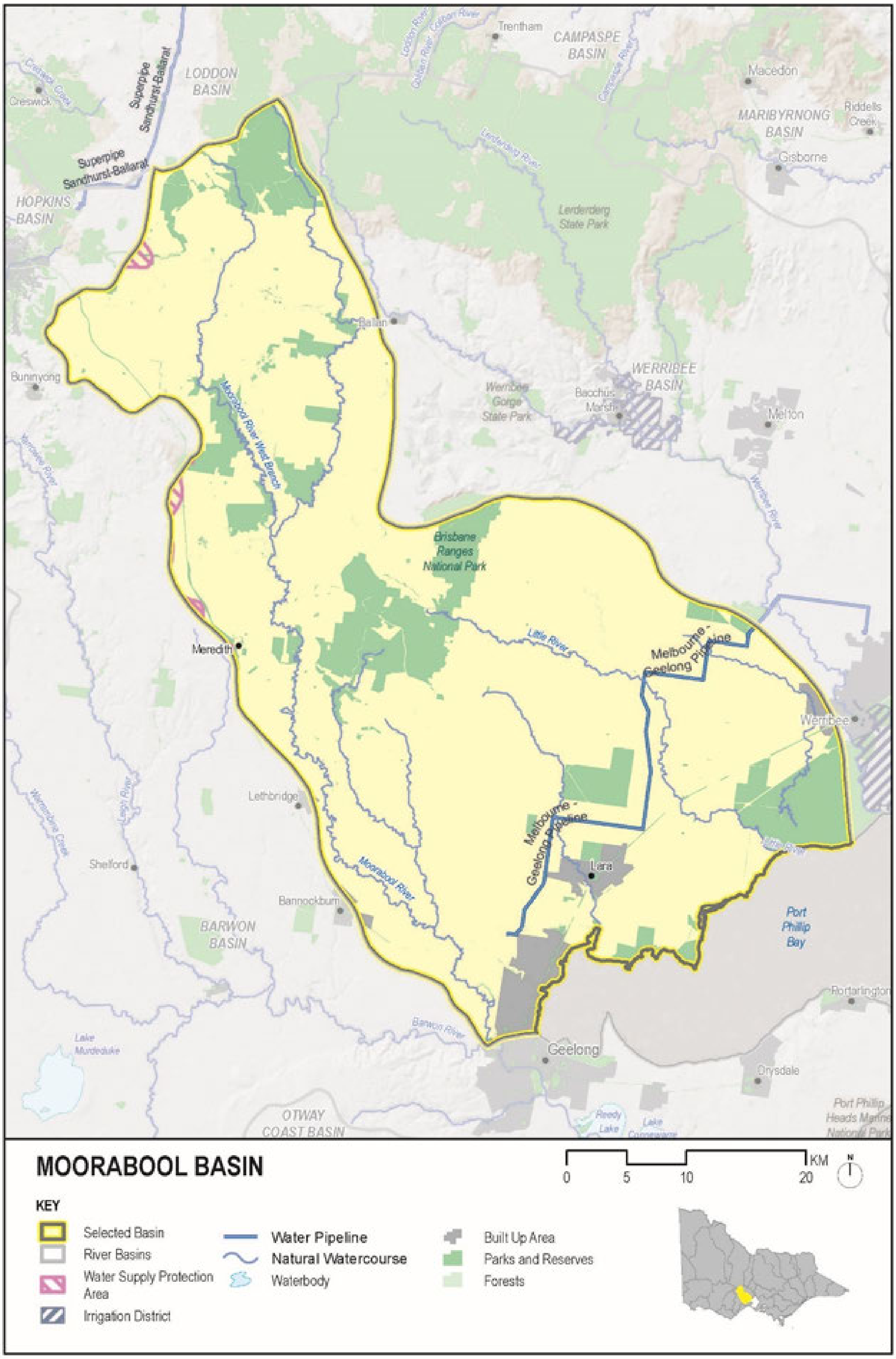
Note

(1) In 2016–17, 5,546 ML was diverted to Melbourne Water. This was previously reported separately: in 2015–16, this number was 6,222 ML.

6.20 Moorabool basin

The Moorabool basin (Figure 6-38) 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 6-38 Map of the Moorabool basin



6.20.1 Water resources overview

Rainfall across the Moorabool basin in 2016–17 was between 100% and 125% of the long-term average.

Catchment inflows were 109% of the long-term average of 97,000 ML, higher than in 2015–16 when inflows were 24% of the long-term average.

Storage levels for the major storages in the basin started the year at 31% of capacity and held 54% at the end of June 2017.

All unregulated streams remained mostly unrestricted throughout 2016–17, except for a licensed diversion ban on the Moorabool River from mid-January 2017. This ban continued to March, when it was decreased to stage 1 restrictions for the remainder of the year.

No urban water use restrictions applied in the Moorabool basin in 2016–17, with all towns remaining on permanent water-saving rules throughout the year.

Table 6-127 shows the responsibilities of the authorities within the Moorabool basin.

Table 6-127 Responsibilities for water resources management in the Moorabool basin

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Southern Rural Water	Manages licensed diversions		
Barwon Water		Supplies Geelong and surrounding towns (1)	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 Obligation to meet passing flow requirements
Central Highlands Water		Supplies Ballarat and surrounding towns (2)	Manages reservoirs on the west Moorabool River and has two-thirds of the share of Lal Lal Reservoir Obliged to meet passing flow requirements
Corangamite Catchment Management Authority			Responsible for waterway management in Moorabool basin
Victorian Environmental Water Holder			Holds and manages entitlements for the environment in the basin

Notes

(1) Geelong's water supply is mainly sourced from the Barwon basin.
(2) Ballarat's water supply is sourced from both the Barwon and Moorabool basins.

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 2016–17, water for the environment in the Moorabool basin comprised:

- the *Moorabool River Environmental Entitlement 2010* comprising 11.9% of inflows — on average 2,500 ML a year, although 1,965 ML was delivered in 2016–17 — held by the VEWH
- 3,364 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
- 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 2016–17, a total of 5,329 ML of environmental water was delivered in-stream in the Moorabool basin.

6.20.2 Surface water resources

6.20.2.1 Water balance

The total volumes of water available and supplied from water resources in the Moorabool basin in 2016–17 are shown in Table 6-128. Most of the water used for consumptive purposes in the basin was sourced from small catchment dams.

Table 6-128 Balance of surface water in the Moorabool basin

Water account component	2016–17 (ML)	2015–16 (ML)
Major on-stream storage		
Volume in storage at start of year	22,689	42,930
Volume in storage at end of year	41,209	22,689
Change in storage	**18,520**	**(20,241)**
Inflows		
Catchment inflow (1)	105,837	23,457
Rainfall on major storages	5,497	2,753
Treated wastewater discharged back to river	0	0
Total inflows	**111,334**	**26,210**
Outflows		
Diversions		
Urban diversions (2)	8,879	8,059
Transfers to Barwon basin (White Swan Reservoir) (3)	6,211	1,140
Licensed diversions from unregulated streams	1,000	963
Small catchment dams	13,012	13,012
Total diversions	***29,101***	***23,174***
Losses		
Evaporation losses from major storages	5,885	5,626
Evaporation from small catchment dams	8,233	8,233
In-stream infiltration to groundwater, flows to floodplain and evaporation	5,391	6,216
Total losses	***19,508***	***20,075***
Water passed at outlet of basin		
River outflows to Port Phillip Bay (Little River) and other small coastal streams	9,634	2,114
River outflows to the Barwon River (Moorabool River)	34,571	1,088
Total water passed at outlet of basin	***44,205***	***3,202***
Total outflows	**92,814**	**46,451**

Notes

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

(2) The urban diversions figure represents water diverted from waterways in the Moorabool basin to directly supply urban customers in both the Barwon and Moorabool basins.

(3) The 6,211 ML transfer represents water that is 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).

6.20.2.2 Storages and flows

The Moorabool basin has six main storages: the Bostock, Korweinguboora, Lal Lal, Moorabool, Upper Stony Creek and Wilson reservoirs. Lal Lal Reservoir accounts for about two-thirds of total storage capacity in the basin. Storage levels for all major storages (greater than 1,000 ML) in the basin were 46,629 ML (54% of capacity) at the end of June 2017, compared to 26,612 ML (31% of capacity) at the beginning of the year (Table 6-129).

Only volumes for major on-stream storages have been included in the water balance: Upper Stony Creek Reservoir has not been included.

Table 6-129 Storage volumes in the Moorabool 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						
Bostock Reservoir	7,455	42	1,088	199	3,428	4,359
Korweinguboora Reservoir (1)	2,327	373	695	127	91	1,032
Lal Lal Reservoir	59,549	21,516	2,374	3,784	11,281	31,387
Moorabool Reservoir	6,192	742	1,134	1,523	3,988	4,341
Wilsons Reservoir	1,010	16	207	252	119	90
Total on-stream storages	**76,533**	**22,689**	**5,497**	**5,885**	**18,907**	**41,209**
Off-stream storages						
Upper Stony Creek Reservoir	9,494	3,923	n/a	n/a	1,497	5,420
Total off-stream storages	**9,494**	**3,923**	**n/a**	**n/a**	**1,497**	**5,420**
Total storage volumes	**86,027**	**26,612**	**5,497**	**5,885**	**20,404**	**46,629**

Notes

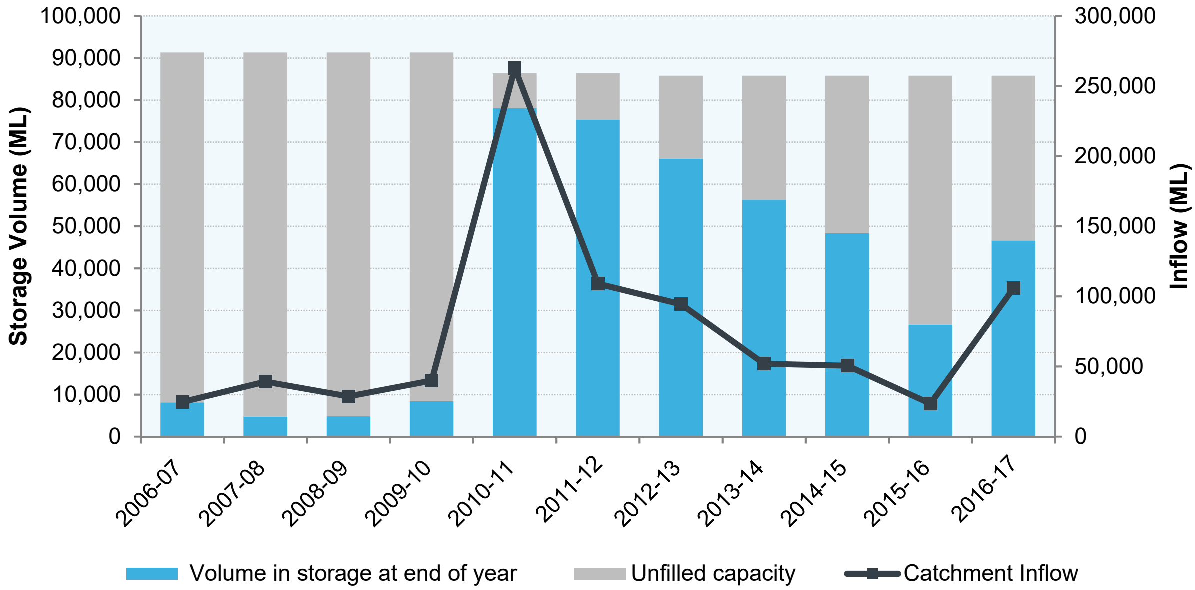
(1) Korweinguboora Reservoir was resurveyed during 2016–17 and the total capacity increased from 2,091 to 2,327.

n/a Information not available.

Catchment inflows were 105,837 ML, or 109% of the long-term average of 97,000 ML. This was higher than the 2015–16 inflows of 23,457 ML (Figure 6-39).

The amount of water flowing from the Moorabool basin into Port Phillip Bay and the Barwon River was 44,205 ML in 2016–17, or 42% of the catchment inflows.

Figure 6-39 Storage volumes and catchment inflows in the Moorabool basin



6.20.2.3 Entitlement volumes and diversions

In the Moorabool basin, surface water is diverted by Barwon Water, Central Highlands Water and licensed diverters. Surface water is also harvested in small catchment dams. 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.

Entitlements in the Moorabool basin include rights granted to individuals (take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations or the VEWH). Rights to water in the Moorabool basin are outlined in Table 6-130.

Table 6-130 Entitlement volumes in the Moorabool basin

Water entitlements	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
Bulk Entitlement (Meredith) Conversion Order 1995	600
Bulk Entitlement (She Oaks) Conversion Order 1995 (3)	2,000
Bulk Entitlement (Upper East Moorabool System) Conversion Order 1995	9,000
Bulk Entitlement (Upper West Moorabool System) Conversion Order 1995	10,500
Moorabool River Environment Entitlement 2010 (4)	n/a
Take and use licences - unregulated surface water	3,567
Total volume of water entitlements in Moorabool basin	**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) Under this entitlement, the authority may take up to 6,000 ML in any three consecutive years.
(4) The *Moorabool River Environmental Entitlement 2010* consists of an 11.9% share of inflows into storage, with the actual volume available in any year varying depending on inflow conditions.
n/a Specified volume not applicable.

Allocation available under bulk entitlements and licences for 2016–17 is presented in Table 6-131. The total volume of water diverted by bulk entitlement holders was slightly higher in 2016–17 than the volume reported in the *Victorian Water Accounts 2015–16*.

The volume of water diverted from unregulated streams by licence holders in the Moorabool basin in 2016–17 (1,000 ML) was higher than the volume (963 ML) reported in the *Victorian Water Accounts 2015–16* (Table 6-131).

Table 6-131 Allocation account balance summary for the Moorabool basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Lal Lal – Barwon	5,925	0	1,185	4,740
Lal Lal – Central Highlands	12,575	0	5,089	7,486
Meredith	600	0	0	600
She Oaks	2,000	0	0	2,000
Upper East Moorabool System	9,000	0	2,605	6,395
Upper West Moorabool System	10,500	0	6,211	4,289
Moorabool River Environment Entitlement (1)	6,892	0	1,965	4,927
Take and use licences - unregulated surface water	3,567	0	1,000	2,568
Total 2016–17	**51,059**	**0**	**18,055**	**33,005**
Total 2015–16	45,138	0	10,403	34,735

Note

(1) Allocation issued to the *Moorabool River Environmental Entitlement 2010* reflects the total available water for the year including carryover and adjustments made in 2016–17. 'Water use' 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 and is not forfeited at the end of the season (see Table 4-4 for details).

The estimated volume of water harvested from small catchment dams represents the largest diversion of water in the Moorabool basin (Table 6-132). The capacity of small catchment dams for Moorabool basin is estimated based on GIS mapping. The GIS data used to derive the capacity values for small catchment dams was updated in 2015–16, to provide a more-accurate measure.

Table 6-132 Estimated small catchment dam information for the Moorabool basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	13,187	6,594	n/a
Registered commercial and irrigation	7,641	6,418	n/a
Total	**20,828**	**13,012**	**21,245**

n/a Information not available.

6.20.3 Recycled water

In the Moorabool basin, Barwon Water operates the Northern Water Plant, a wastewater treatment plant, and Central Highlands Water operates the Gordon Wastewater Treatment Plant. About 94% of wastewater was recycled in 2016–17, a slight decrease from 96% in 2015–16. Most of the recycled water within the basin was used by a refinery.

Table 6-133 shows the volumes of recycled water in the Moorabool basin in 2016–17. Where water has been recycled within the plant process, this volume has not been included in the percent recycled value.

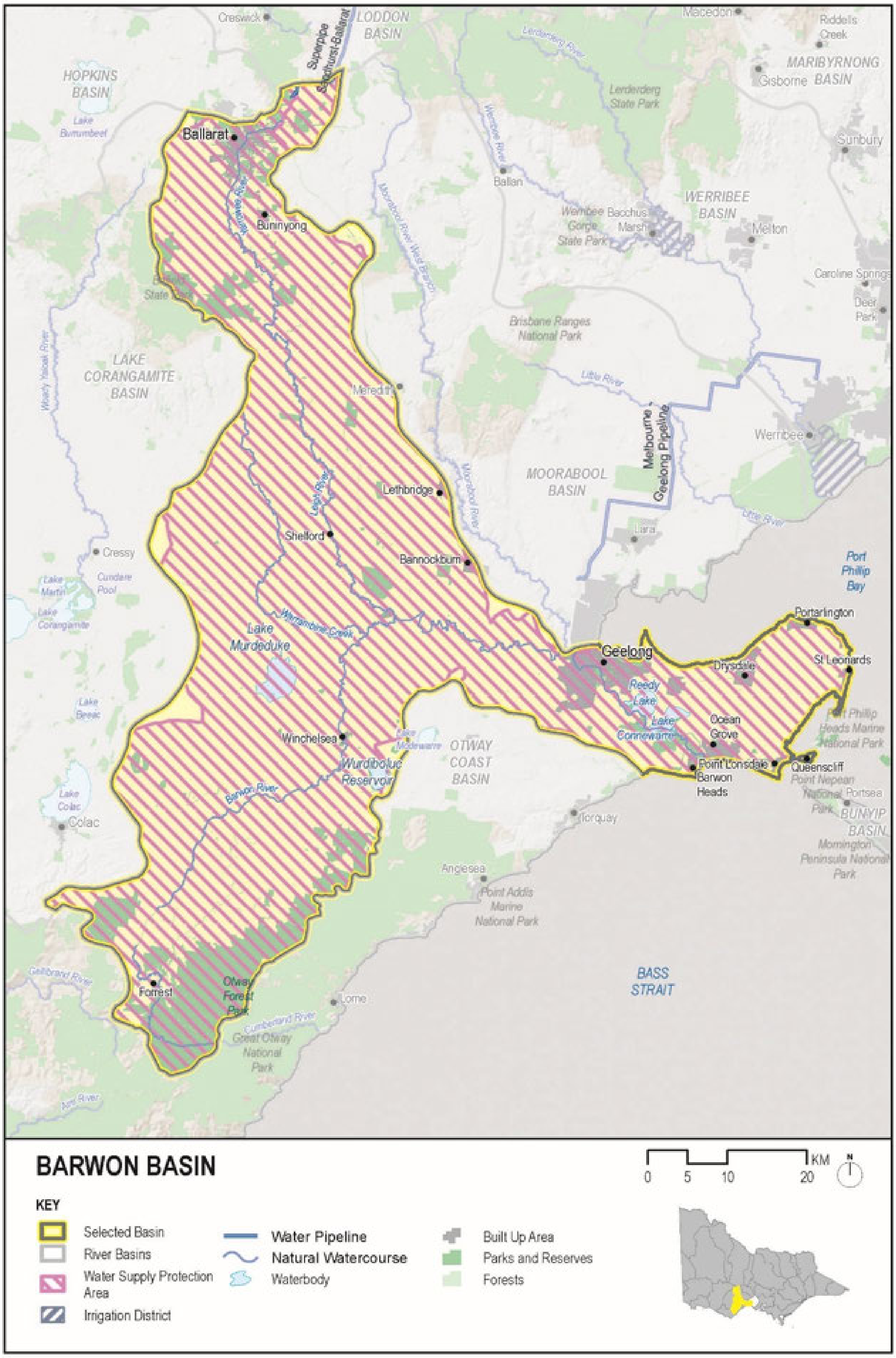
Table 6-133 Volume and use of recycled water in the Moorabool basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled (excludes within plant process)	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	30	14	47%	0	14	0	0	0	16
Northern Water Plant	1,257	1,257	95%	1,198	0	0	59	0	0
Total 2016–17	**1,287**	**1,271**	**94%**	**1,198**	**14**	**0**	**59**	**0**	**16**
Total 2015–16	1,467	1,467	96%	1,411	0	0	57	0	0

6.21 Barwon basin

The Barwon basin (Figure 6-40) 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 6-40 Map of the Barwon basin



6.21.1 Water resources overview

Rainfall in the Barwon basin in 2016–17 was between 100% and 125% of the long-term average, with the southernmost tip near the West Barwon Reservoir receiving between 80% and 100% of the long-term average.

Catchment inflows in the Barwon basin in 2016–17 were 93% of the long-term average, a large increase from 29% in 2015–16.

In contrast to the previous year when storages ended the year lower than they began, storage levels in the Barwon basin started the year at 35% and ended the year at 58% of total capacity.

Good spring rains resulted in good flows along the Barwon River, which was unrestricted until February 2017 when zone 1 and 2 were placed on stage 3 until March. These were then reduced to stage 1 from April to June. There were no restrictions for zone 3.

No urban water use restrictions applied in the Barwon basin in 2016–17, with all towns remaining on permanent water-saving rules throughout the year.

Table 6-134 shows the responsibilities of the authorities within the Barwon basin.

Table 6-134 Responsibilities for water resources management in the Barwon basin

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Southern Rural Water	Manages licensed diversions		
Barwon Water		Geelong and surrounding towns (1)	Operates West Barwon Reservoir and Lake Wurdee Boluc Obliged to meet passing flow requirements
Central Highlands Water		Ballarat and surrounding towns (2)	Operates White Swan and Gong Gong reservoirs Obliged to meet passing flow requirements
Victorian Environmental Water Holder			Holds and manages entitlements for the environment in the basin
Corangamite Catchment Management Authority			Manages waterways for the whole of the Barwon basin

Notes
(1) Geelong's water supply is also sourced from the Moorabool basin, and from the Melbourne system via the Melbourne to Geelong Pipeline.
(2) Ballarat's water supply is mainly sourced from the Moorabool basin and the Campaspe and Goulburn basin via the Goldfields Superpipe.

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 2016–17, water for the environment in the Barwon basin comprised:

- the *Barwon River Environmental Entitlement 2011*
- 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.

6.21.2 Surface water resources

6.21.2.1 Water balance

The total volumes of water available and supplied from water resources in the Barwon basin in 2016–17 are shown in Table 6-135. The major storages in the Barwon basin are the West Barwon and Wurdee Buloc reservoirs operated by Barwon Water, and the White Swan and Gong Gong reservoirs operated by Central Highlands Water.

Transfers from the Moorabool basin to the Barwon basin increased from 1,140 ML in 2015–16 to 6,211 ML in 2016–17. This water was transferred to White Swan Reservoir and used to supply the Ballarat system. The Goldfields Superpipe was used to transfer 1,359 ML from the Campaspe basin to White Swan Reservoir to augment supplies to

Ballarat. The greater Geelong area, serviced by Barwon Water, is a major water user in the Barwon basin. Water supplied to Geelong is also sourced from the Moorabool basin.

Table 6-135 Balance of surface water in the Barwon basin

Water account component	2016–17 (ML)	2015–16 (ML)
Major on-stream storage		
Volume in storage at start of year	12,967	23,961
Volume in storage at end of year	22,627	12,967
Change in storage	**9,660**	**(10,994)**
Inflows		
Catchment inflow (1)	335,884	104,820
Rainfall on major storages	3,477	2,002
Inflows from the Moorabool River	34,571	1,088
Transfers from the Corangamite basin via Woady Yaloak Channel	0	0
Transfers from Moorabool basin to White Swan Reservoir (2)	6,211	1,140
Transfers from Campaspe basin to White Swan Reservoir	1,359	7,329
Treated wastewater discharged back to river	11,072	8,206
Total inflows	**392,574**	**124,585**
Outflows		
Diversions		
Urban diversions	43,314	33,013
Licensed diversions from unregulated streams	1,213	1,767
Small catchment dams	20,793	20,793
Total diversions	***65,320***	***55,573***
Losses		
Evaporation losses from major storages	1,871	2,779
Evaporation from small catchment dams	15,883	15,883
In-stream infiltration to groundwater, flows to floodplain and evaporation	10,457	9,186
Total losses	***28,211***	***27,848***
Water passed at outlet of basin		
River outflows to the ocean	289,383	52,158
Total water passed at outlet of basin	***289,383***	***52,158***
Total outflows	**382,914**	**135,580**

Notes

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

(2) The 6,211 ML transfer represents water that is transferred to White Swan Reservoir from the Moorabool basin before being supplied to urban customers in the Ballarat area (which is located within both the Barwon and Moorabool basins).

6.21.2.2 Storages and flows

Storage levels for all major storages in the basin started the year at 26,897 ML in July 2016 and were 45,575 ML (58% of capacity) at the end of June 2017. Only the on-stream storages of West Barwon Dam, Gong Gong Reservoir and White Swan Reservoir are included in the water balance. The volume reported in the 'Catchment inflows less regulated releases' column of Table 6-136 is the balancing item for each storage. It represents the flows of water in or out of the storage that are not shown as rainfall or evaporation, and may include other minor components influencing the change in storage during the year.

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	247	205	241	1,313	1,524
West Barwon Reservoir (1)	22,064	4,446	2,069	370	2,661	8,806
White Swan Reservoir (2)	14,107	8,274	1,203	1,260	4,080	12,297
Total on-stream storages	**38,073**	**12,967**	**3,477**	**1,871**	**8,054**	**22,627**
Off-stream storages						
Wurdee Boluc Reservoir (3)	40,431	13,930	n/a	n/a	9,010	22,940
Total off-stream storages	**40,431**	**13,930**	**n/a**	**n/a**	**9,010**	**22,940**
Total storage volumes	**78,504**	**26,897**	**3,477**	**1,871**	**17,064**	**45,567**

Notes

(1) Total capacity includes dead storage volume of 560 ML.

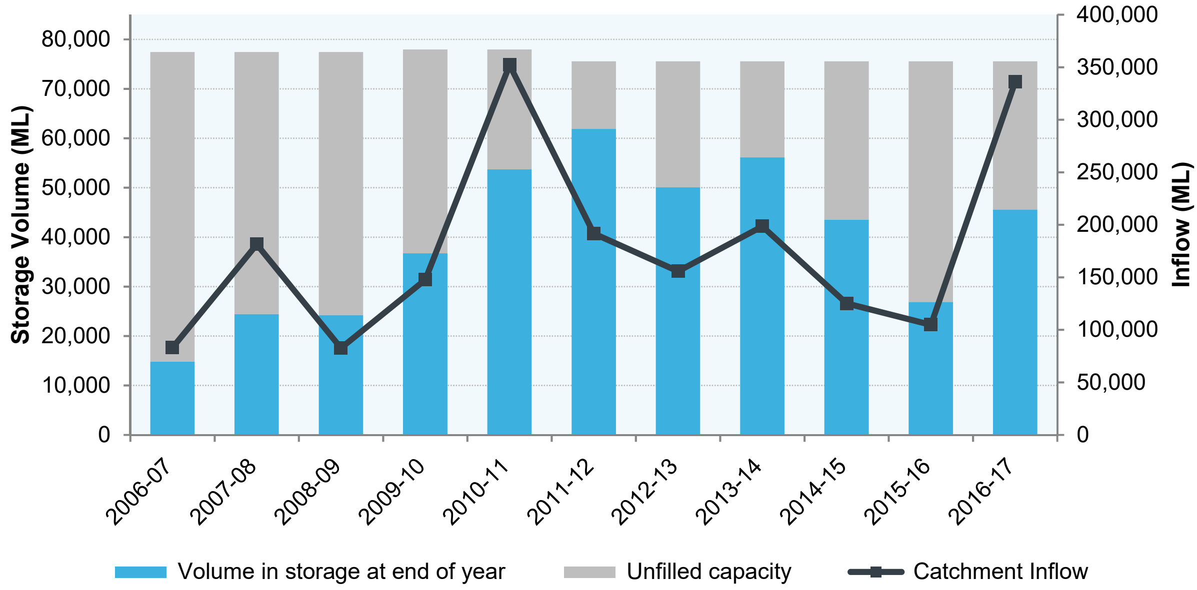
(2) White Swan Reservoir is treated as an on-stream storage for the purpose of the water balance.

(3) Total capacity includes dead storage volume of 2,077 ML.

Catchment inflows to the Barwon basin amounted to 335,884 ML in 2016–17, which is 93% of the long-term average (of 360,000 ML). This is an increase from inflows of 29% of the long-term average in 2015–16 (Figure 6-41).

The amount of water flowing from the Barwon basin into Corio Bay and Bass Strait was 289,383 ML in 2016–17. This represents 86% of the catchment inflows to the basin.

Figure 6-41 Storage volumes and catchment inflows in the Barwon basin



6.21.2.3 Entitlement volumes and diversions

In the Barwon basin, surface water is diverted by Barwon Water, Central Highlands Water and licensed diverters, and water is harvested in small catchment dams.

Entitlements in the Barwon basin include rights granted to individuals (for example, take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations or environmental entitlements granted to the VEWH). Rights to water in the Barwon basin are outlined in Table 6-137.

Table 6-137 Entitlement volumes in the Barwon basin

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (Upper Barwon System) Conversion Order 2002 (1)	43,466
Bulk Entitlement (Yarrowee-White Swan System) Conversion Order 2002 (2) (3)	12,267
Barwon River Environmental Entitlement 2011 (4)	n/a
Take and use licences - unregulated surface water	5,510
Total volume of water entitlements in the Barwon basin	**61,243**

Notes
(1) This entitlement specifies that the authority may take up to 130,400 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.
(3) This bulk entitlement 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.
(4) Use of this entitlement depends on suitable river heights as specified in the entitlement.
n/a Specified volume not applicable

Water available under bulk entitlements and licences for 2016–17 is presented in Table 6-138. The total volume of water diverted by bulk entitlement holders was greater in 2016–17 than the volume reported in the *Victorian Water Accounts 2015–16*.

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 6-138 Allocation account balance summary for the Barwon basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Upper Barwon system	43,466	0	36,111	7,355
Yarrowee-White Swan system	12,267	0	7,203	5,064
Barwon River Environmental Entitlement (1)	n/a	n/a	n/a	n/a
Take and use licences - unregulated surface water	5,510	0	1,213	4,297
Total 2016–17	**61,243**	**0**	**44,527**	**16,716**
Total 2015–16	61,399	(5)	34,780	26,614

Note
(1) Use under this entitlement depends on suitable river heights.

The estimated volume of water harvested from small catchment dams represents a significant portion of the total surface water diversions in the Barwon basin (Table 6-139). The capacity of small catchment dams for Barwon basin is estimated based on GIS mapping. The GIS data used to derive the capacity values for small catchment dams was updated in 2015–16, to provide a more-accurate measure.

Table 6-139 Estimated small catchment dam information for the Barwon basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	24,327	12,164	n/a
Registered commercial and irrigation	10,273	8,629	n/a
Total	**34,600**	**20,793**	**36,676**

n/a Information not available.

6.21.3 Recycled water

Barwon Water and Central Highlands Water operate treatment plants within the Barwon basin. Overall, 7% of wastewater was recycled in 2016–17, a slight decrease on 10% from 2015–16.

Table 6-140 shows the volumes and uses of recycled water in the Barwon basin in 2016–17. Where water has been recycled within the plant process, this volume has not been included in the percent recycled value.

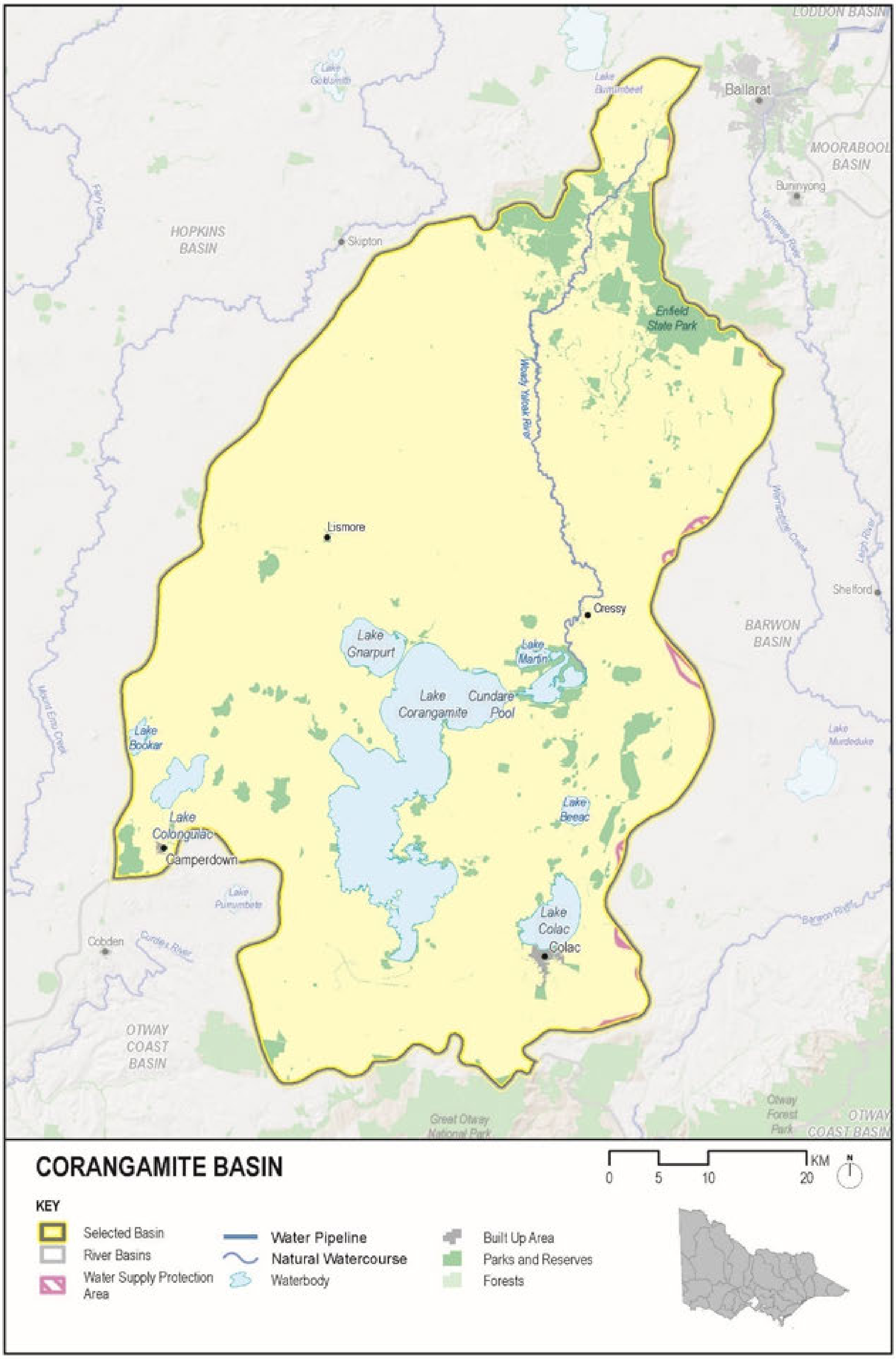
Table 6-140 Volume and use of recycled water in the Barwon basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled (excludes within plant process)	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	2,981	332	5%	0	0	147	185	2,648	0
Ballarat South	8,508	84	0%	0	0	0	84	8,424	0
Bannockburn	280	280	40%	0	112	0	168	0	0
Black Rock	21,504	1,894	9%	935	959	0	0	0	19,610
Portarlington	453	453	35%	0	158	0	296	0	0
Winchelsea	155	155	22%	0	34	0	121	0	0
Total 2016–17	**33,881**	**3,198**	**7%**	**935**	**1,263**	**147**	**854**	**11,072**	**19,610**
Total 2015–16	31,486	5,218	10%	949	1,822	335	2,112	8,206	18,063

6.22 Corangamite basin

The Corangamite basin (Figure 6-42) 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 6-42 Map of the Corangamite basin



6.22.1 Water resources overview

In 2016–17, rainfall in the Corangamite basin was between 100% and 125% of the long-term average, with a small pocket north of Lake Gnarpurt receiving between 125% to 150% of the long-term average.

Catchment inflows across the basin were 123% of the long-term average of 316,000 ML, significantly higher than in 2015–16 when the inflows were 13% of the long-term average. The amount of water flowing from the Corangamite basin into the Ramsar-listed Western District Lakes represented 97% of the catchment inflows in 2016–17.

Unlike the previous year when there were no restrictions on licensed diversions from unregulated streams, a licensed diversion ban was in place on Lake Tooliorook from November 2016 to June 2017.

No urban water use restrictions were applied in the Corangamite basin in 2016–17, with all remaining towns on permanent water-saving rules throughout the year.

Table 6-141 shows the responsibilities of the authorities within the Corangamite basin.

Table 6-141 Responsibilities for water resources management in the Corangamite basin

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
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 (from the Ballarat supply which is sourced in the Moorabool and Goulburn basins) (1)	
Wannon Water		Provides urban water supply to Camperdown, Lismore and Derrinallum (from the Otway Coast basin)	
Corangamite Catchment Management Authority			Manages waterways for the Corangamite basin

Note
(1) Ballarat's water supply is mainly sourced from the Barwon and Moorabool basins.

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 2016–17, 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.

6.22.2 Surface water resources

6.22.2.1 Water balance

The total volumes of water available and supplied from water resources in the Corangamite basin in 2016–17 are shown in Table 6-142. Urban water use within the Corangamite basin is mostly supplied from the Otway Coast basin and the Moorabool basin due to the availability of higher-quality water. No storage information is recorded in the water balance as there are no major on-stream storages in the Corangamite basin.

Table 6-142 Balance of surface water in the Corangamite basin

Water account component	2016–17 (ML)	2015–16 (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)	388,612	40,645
Rainfall on major storages	-	-
Treated wastewater discharged back to river	1,955	1,453
Total inflows	**390,567**	**42,098**

Outflows		
Diversions		
Urban diversions	0	0
Licensed diversions from unregulated streams	108	98
Small catchment dams	8,365	8,365
Total diversions	***8,473***	***8,463***
Losses		
Evaporation losses from major storages	-	-
Evaporation from small catchment dams	6,391	6,391
In-stream infiltration to groundwater, flows to floodplain and evaporation (2)	n/a	n/a
Total losses	***6,391***	***6,391***
Water passed at outlet of basin		
River outflows to the Corangamite Lakes	375,704	27,244
River outflows to Barwon basin via Woady Yaloak Channel	0	0
Total water passed at outlet of basin	***375,704***	***27,244***
Total outflows	**390,567**	**42,098**

Notes
(1) Catchment inflows is the balancing item in this water balance. It is the difference between the total outflows and the known inflows.
(2) No suitable model is available to make an estimate of in-stream losses.

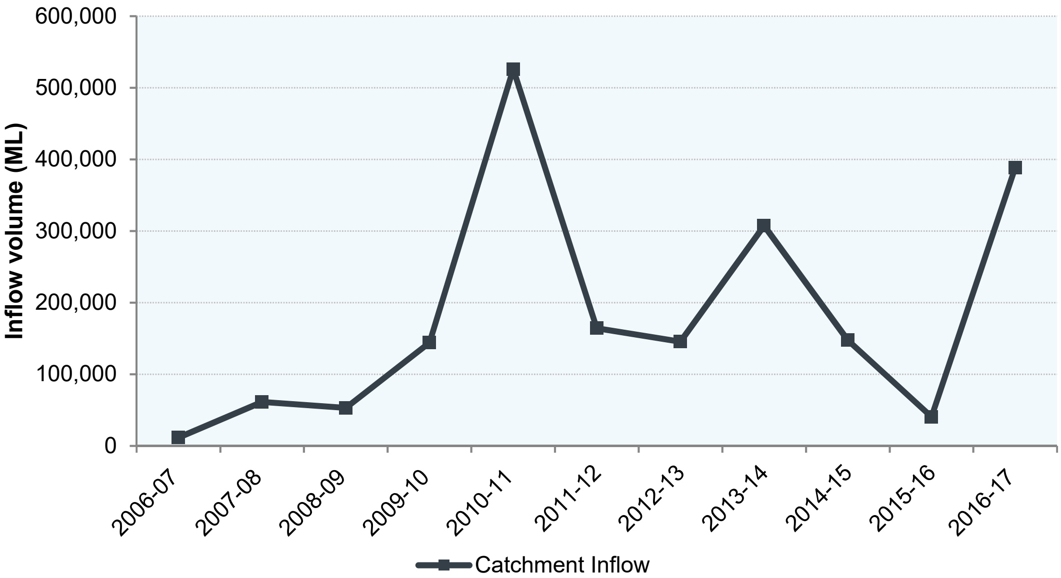
6.22.2.2 Storages and flows

Catchment inflows across the basin were 388,612 ML or 123% of the long-term average, significantly higher than in 2015–16 when the inflows were 40,645 ML or 13% of the long-term average of 316,000 ML (Figure 6-43).

Outflows from the Corangamite basin into the Corangamite Lakes were 375,704 ML in 2016–17, or 97% of the catchment inflows.

There are no major water supply storages in the Corangamite basin.

Figure 6-43 Catchment inflows in the Corangamite basin



6.22.2.3 Entitlement volumes and diversions

In the Corangamite basin, surface water is diverted from unregulated streams by licence holders and surface water is harvested in small catchment dams. No water authorities divert surface water in this basin.

The total licensed volume and the estimated volume of water diverted by licence holders in the basin was the same in 2016–17 as the volume reported in the *Victorian Water Accounts 2015–16* (Table 6-143).

Table 6-143 Entitlement volumes in the Corangamite basin

Water entitlements	Annual entitlement volume (ML)
Take and use licences – unregulated surface water	1,177
Total volume of water entitlements in the Corangamite basin	**1,177**

Allocation available under take and use licences in the Corangamite basin for 2016–17 is presented in Table 6-144.

Table 6-144 Allocation account balance summary for the Corangamite basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Take and use licences - unregulated surface water	1,177	0	108	1,069
Total 2016–17	**1,177**	**0**	**108**	**1,069**
Total 2015–16	1,177	0	98	1,079

The estimated volume of water harvested from small catchment dams represents the largest diversion of surface water in the Corangamite basin (Table 6-145). The capacity of small catchment dams for Corangamite basin is estimated based on GIS mapping. The GIS data used to derive the capacity values for small catchment dams was updated in 2015–16, to provide a more-accurate measure.

Table 6-145 Estimated small catchment dam information for the Corangamite basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	10,116	5,058	n/a
Registered commercial and irrigation	3,937	3,307	n/a
Total	**14,053**	**8,365**	**14,756**

n/a Information not available.

6.22.3 Recycled water

Barwon Water and Wannon Water operate treatment plants within the Corangamite basin. Overall, 19% of wastewater was recycled in 2016–17, an increase from 15% in 2015–16. Recycled water was primarily used for agricultural purposes in this region (Table 6-146). Where water has been recycled within the plant process, this volume has not been included in the percent recycled value.

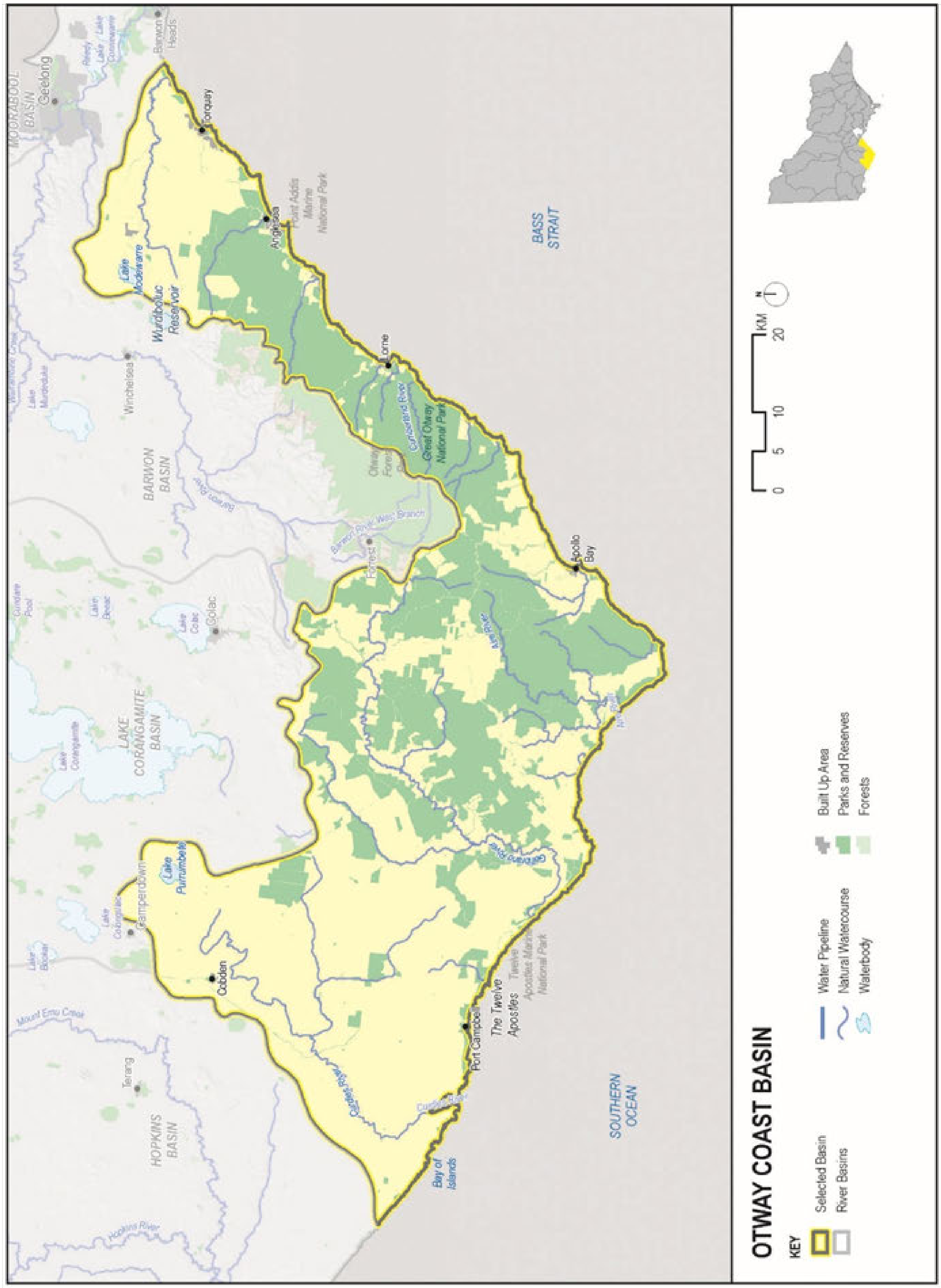
Table 6-146 Volume and use of recycled water in the Corangamite basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled (excludes within plant process)	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	48	48	100%	0	48	0	0	0	0
Camperdown Municipal	488	423	87%	12	411	0	0	65	0
Colac	1,890	0	0%	0	0	0	0	1,890	0
Total 2016–17	**2,426**	**471**	**19%**	**12**	**459**	**0**	**0**	**1,955**	**0**
Total 2015–16	1,709	256	15%	17	239	0	0	1,453	0

6.23 Otway Coast basin

The Otway Coast basin (Figure 6-44) 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 6-44 Map of the Otway Coast basin



6.23.1 Water resources overview

In 2016–17, rainfall throughout most of the Otway Coast basin was between 100% and 125% of the long-term average, while in a small pocket bordering the Barwon basin rainfall was between 80% and 100% of the average.

Catchment inflows in the Otway Coast basin in 2016–17 were 106% of the long-term average of 884,000 ML, more than double the 47% recorded in 2015–16. The amount of water flowing into Bass Strait represented 96% of the catchment inflows in the basin in 2016–17.

Storage levels in West Gellibrand Reservoir started 2015–16 at 64% and ended the year at 71% of total capacity.

Similar to the previous year, there were stage 1 restrictions on licensed diversions on the Curdies River between January and June 2017 and stage 4 restrictions on the Carlisle River for the month of February 2017.

Barwon Water placed Lorne on stage 2 restrictions in March 2017 and raised the level to stage 3 in May. Later in May, Barwon Water placed the Apollo Bay system on stage 3, until all restrictions were removed on 10 June 2017.

No other urban water use restrictions applied in the Otway Coast basin in 2016–17, with all remaining towns on permanent water-saving rules throughout the year.

Table 6-147 shows the responsibilities of the authorities within the Otway Coast basin.

Table 6-147 Responsibilities for water resources management in the Otway Coast basin

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Southern Rural Water	Manages licensed diversions		
Wannon Water		Supplies towns including Port Campbell, Peterborough, Simpson and Cobden	Obliged to meet passing flow requirements
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). Also, transfers water out of the basin to supply Colac and surrounding towns	Operates West Gellibrand Reservoir and other reservoirs used to supply towns Obliged to meet passing flow requirements
Corangamite Catchment Management Authority			Manages waterways for the Otway Coast basin

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
- native fish community (such as river blackfish and Australian grayling) and their habitat (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 2016–17, 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.

6.23.2 Surface water resources

6.23.2.1 Water balance

The total volumes of water available and supplied from water resources in the Otway Coast basin in 2016–17 are shown in Table 6-148.

Table 6-148 Balance of surface water in the Otway Coast basin

Water account component	2016–17 (ML)	2015–16 (ML)
Major on-stream storage		
Volume in storage at start of year	1,181	1,374
Volume in storage at end of year	1,327	1,181
Change in storage	**146**	**(193)**
Inflows		
Catchment inflow (1)	938,488	419,384
Rainfall on major storages	363	272
Treated wastewater discharged back to river	210	28
Total inflows	**939,060**	**419,684**
Outflows		
Diversions		
Urban diversions	12,584	13,865
Licensed diversions from unregulated streams	766	855
Small catchment dams	15,556	15,556
Total diversions	***28,906***	***30,276***
Losses		
Evaporation losses from major storages	43	209
Evaporation from small catchment dams	4,591	4,591
In-stream infiltration to groundwater, flows to floodplain and evaporation (2)	n/a	n/a
Total losses	***4,634***	***4,800***
Water passed at outlet of basin		
River outflows to the ocean	905,374	384,801
Total water passed at outlet of basin	***905,374***	***384,801***
Total outflows	**938,914**	**419,877**

Notes

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

(2) No suitable model is available to make an estimate of in-stream losses.

6.23.2.2 Storages and inflows

The only major storage in the basin is the West Gellibrand Reservoir, which began the year at 64% of capacity and unlike the previous year was higher at 71% by the end of June 2017 (Table 6-149).The volume reported in the 'Catchment inflows less regulated releases' column of Table 6-149 is the balancing item for each storage. It represents the flows of water in or out of the storage that are not shown as rainfall or evaporation and may include other minor components influencing the change in storage during the year.

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	1,181	363	43	(174)	1,327
Total storage volumes	**1,856**	**1,181**	**363**	**43**	**(174)**	**1,327**

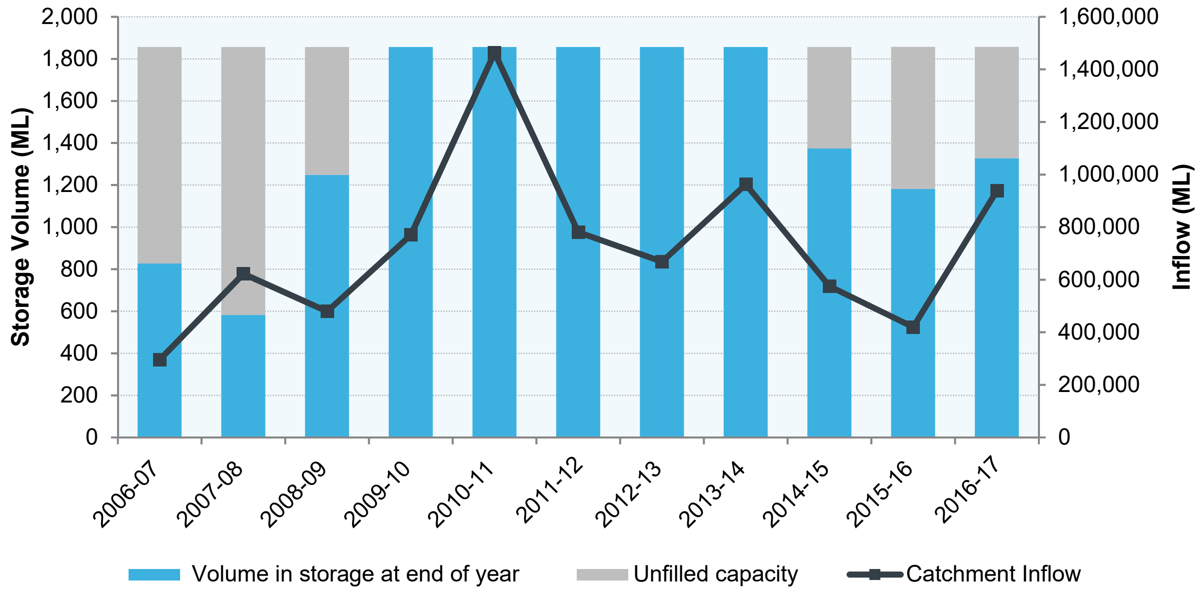
Note

(1) Major storages are greater than 1,000 ML.

Catchment inflows in the Otway Coast basin in 2016–17 were 938,488 ML or 106% of the long-term average of 884,000 ML, compared to 419,384 ML or 47% in 2015–16 (Figure 6-45).

The amount of water flowing from the Otway Coast basin into Bass Strait increased to 905,374 ML in 2016–17. This represented 96% of the catchment inflows into the basin, compared to 384,801 ML or 92% in 2015–16.

Figure 6-45 Storage volumes and catchment inflows



6.23.2.3 Entitlement volumes and diversions

In the Otway Coast basin, surface water is diverted by Barwon Water, Wannon Water and licensed diverters. Surface water is also harvested in small catchment dams.

Entitlements in the Otway Coast basin include rights granted to individuals (take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations). Rights to water in the Otway Coast basin are outlined in Table 6-150.

Table 6-150 Entitlement volumes in the Otway Coast basin

Water entitlements	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	6,043
Total volume of water entitlements in Otway Coast basin	**25,710**

Allocation available under bulk entitlements and licences for 2016–17 is presented in Table 6-151. The volume of water diverted from unregulated streams by licence holders in the Otway Coast basin was less in 2016–17 than the volume (855 ML) reported in the *Victorian Water Accounts 2015–16*.

Table 6-151 Allocation account balance summary for the Otway Coast basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Aireys Inlet	317	0	0	317
Apollo Bay	800	0	368	432
Colac	5,400	0	3,317	2,083
Gellibrand	60	0	17	43
Lorne	510	0	420	90
Otway system	12,580	0	8,463	4,117
Take and use licences - unregulated surface water	6,830	0	766	6,064
Total 2016–17	**26,497**	**0**	**13,350**	**13,147**
Total 2015–16	26,371	0	14,720	11,652

The estimated volume of water harvested from small catchment dams represents a significant portion of the total diversions in the Otway Coast basin (Table 6-152). The capacity of small catchment dams for Otway Coast basin is estimated based on GIS mapping. The GIS data used to derive the capacity values for small catchment dams was updated in 2015–16, to provide a more-accurate measure.

Table 6-152 Estimated small catchment dam information for the Otway Coast basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	14,217	7,109	n/a
Registered commercial and irrigation	10,057	8,448	n/a
Total	**24,274**	**15,556**	**20,147**

n/a Information not available.

6.23.3 Recycled water

Barwon Water and Wannon Water operate treatment plants within the Otway Coast basin. Overall, 13% of wastewater was recycled in 2016–17, a decrease from 20% in 2015–16.

Table 6-153 shows the volumes and uses of recycled water in the Otway Coast basin in 2016–17. Where water has been recycled within the plant process, this volume has not been included in the percent recycled value.

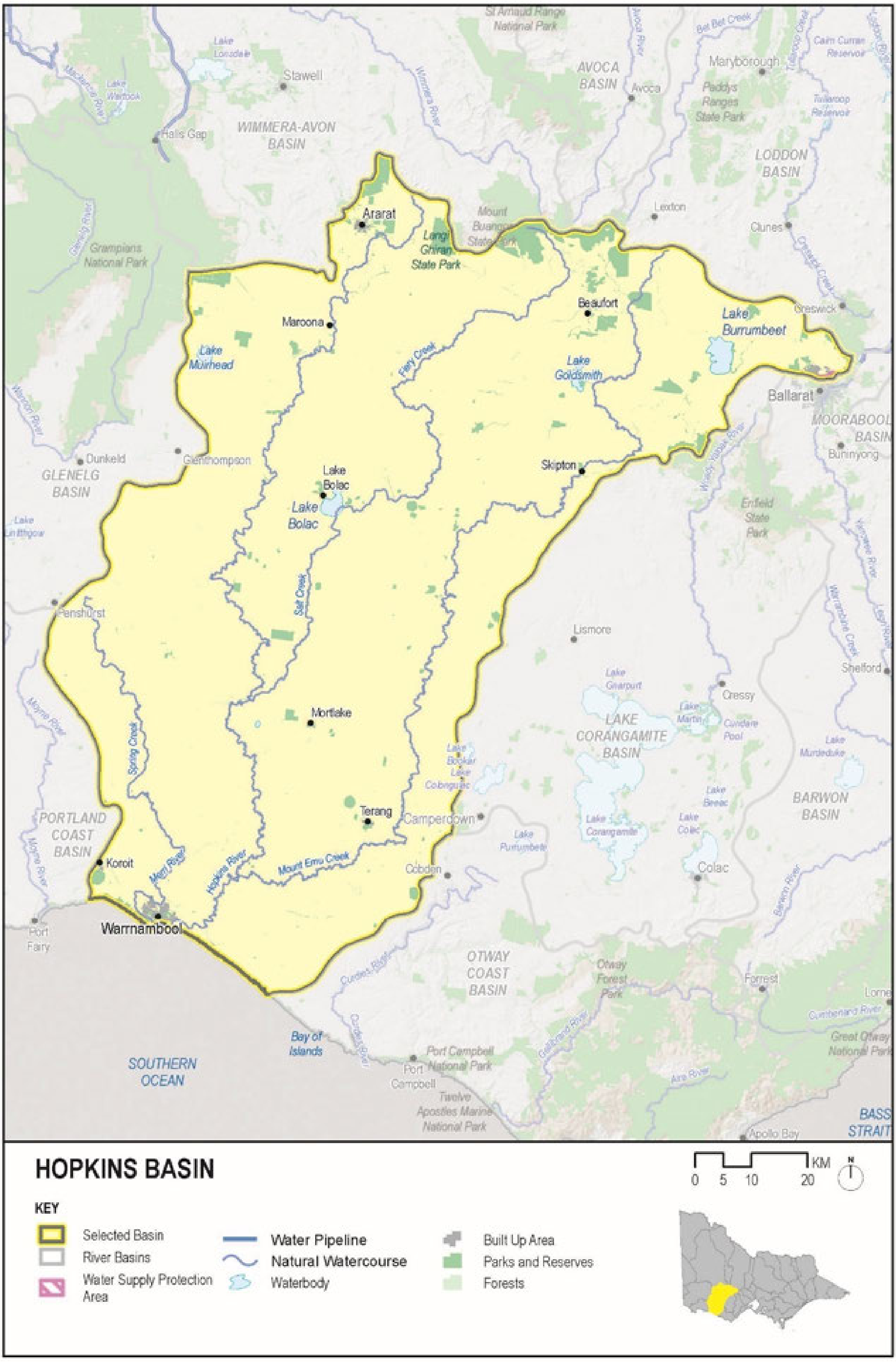
Table 6-153 Volume and use of recycled water in the Otway Coast basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled (excludes within plant process)	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	32	32	0%	0	0	0	32	0	0
Anglesea	351	15	4%	0	15	0	0	0	336
Apollo Bay	462	0	0%	0	0	0	0	0	462
Cobden	230	93	40%	0	93	0	0	138	0
Lorne	340	15	0%	0	0	0	15	0	325
Peterborough	1	1	100%	0	1	0	0	0	0
Port Campbell	64	36	56%	0	36	0	0	28	0
Simpson	21	0	0%	0	0	0	0	21	0
Timboon	86	64	74%	0	64	0	0	23	0
Total 2016–17	**1,587**	**256**	**13%**	**0**	**209**	**0**	**47**	**210**	**1,123**
Total 2015–16	1,260	392	20%	0	248	0	144	28	839

6.24 Hopkins basin

The Hopkins basin (Figure 6-46) is located in south-west Victoria. The two major rivers within the basin are the Merri River and Hopkins River.

Figure 6-46 Map of the Hopkins basin



6.24.1 Water resources overview

Rainfall throughout most of the Hopkins basin in 2016–17 was between 100% and 125% of the long-term average. An area west of Lake Bolac bordering the southernmost point of the Glenelg basin reached between 125% and 150% of the long-term average rainfall.

Catchment inflows in 2016–17 were 87% of the long-term average, more than in 2015–16 when annual inflows were only 13% of the long-term average. The volume of water flowing from the Hopkins basin into Bass Strait represented 93% of the catchment inflows, compared to 48% in 2015–16.

There were restrictions on licensed diversions from the Hopkins River, Mt Emu Creek and the Merri River in July 2016, which were all lifted by August. Stage 3 restrictions were in put place in January on the Merri River and Mt Emu Creek and in March on the Hopkins River. Restrictions increased to stage four on Mt Emu Creek in March, with restrictions on all three streams dropping down to stage 1 from April to June.

Unlike the previous year, there were no urban restrictions applied in the Hopkins basin in 2016–17, with all towns remaining on permanent water-saving rules throughout the year.

Table 6-154 shows the responsibilities of the authorities within the Hopkins basin.

Table 6-154 Responsibilities for water resources management in the Hopkins basin

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
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 in the south of the basin including Warrnambool	
Grampians Wimmera Mallee Water		Supplies towns in the north of the basin including Ararat	
Central Highlands Water		Supplies towns in the north-east of the basin including Beaufort and Skipton	Obliged to meet passing flow requirements
Glenelg Hopkins Catchment Management Authority			Manages waterways in the whole of the Hopkins basin

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 2016–17, 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.

6.24.2 Surface water resources

6.24.1 Water balance

The total volumes of water available and supplied from water resources in the Hopkins basin in 2016–17 are shown in Table 6-155. No storage information is recorded in the water balance as there are no major on-stream storages in the basin. Small catchment dams harvest most of the water used for consumptive purposes.

Table 6-155 Balance of surface water in the Hopkins basin

Water account component	2016–17 (ML)	2015–16 (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)	550,033	80,845
Rainfall on major storages	-	-
Treated wastewater discharged back to river	479	0
Total inflows	**550,511**	**80,845**
Outflows		
Diversions		
Urban diversions	164	206
Licensed diversions from unregulated streams	2,018	2,458
Small catchment dams	21,446	21,446
Total diversions	***23,628***	***24,110***
Losses		
Evaporation losses from major storages	-	-
Losses from small catchment dams	17,749	17,749
In-stream infiltration to groundwater, flows to floodplain and evaporation (2)	n/a	n/a
Total losses	***17,749***	***17,749***
Water passed at outlet of basin		
River outflows to the ocean	509,134	38,985
Total water passed at outlet of basin	***509,134***	***38,985***
Total outflows	**550,511**	**80,845**

Notes
(1) Catchment inflows is the balancing item in this water balance. It is the difference between the total outflows and the known inflows.
(2) No suitable model is available to make an estimate of in-stream losses.

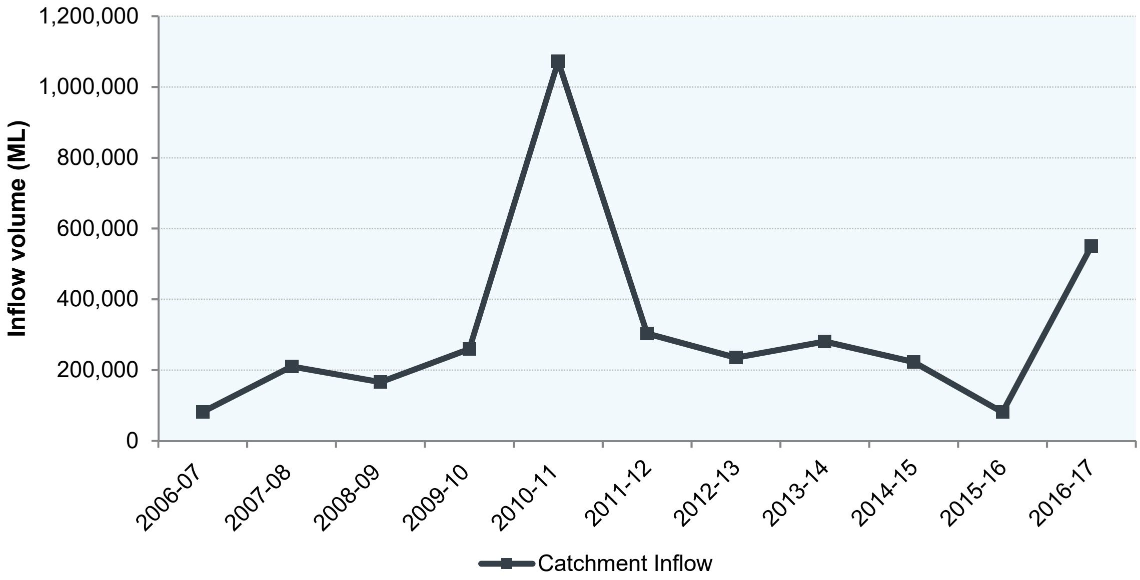
6.24.2.2 Storages and flows

Catchment inflows in 2016–17 were 550,033 ML or 87% of the long-term average (of 635,000 ML), a large increase on the inflows recorded in 2015–16, which were 80,845 ML or 13% (Figure 6-47).

The volume of water flowing from the Hopkins basin into Bass Strait was 509,134 ML in 2016–17, which represented 93% of the catchment inflows. This is a significant increase from 38,985 ML in 2015–16, which represented 48% of catchment inflows.

There are no major storages — storages greater than 1,000 ML — in the Hopkins basin.

Figure 6-47 Catchment inflows in the Hopkins basin



6.24.2.3 Entitlement volumes and diversions

In the Hopkins basin, bulk entitlements to surface water are held by Central Highlands Water, Grampians Wimmera Mallee Water and licensed diverters. Surface water is diverted by licensed diverters and is also harvested into small catchment dams.

Entitlements include rights granted to individuals (take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations). Rights to water in the Hopkins basin are outlined in Table 6-156.

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 are located in the Wimmera.

Table 6-156 Entitlement volumes in the Hopkins basin

Water entitlements	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 (1)	11,407
Total volume of water entitlements in the Hopkins basin	**12,036**

Note

(1) The annual entitlement volume of take and use licences in 2016–17 increased from 11,084 ML in 2015–16, because of an auction held by Southern Rural Water.

Allocation available under bulk entitlements and licences for 2016–17 is presented in Table 6-157. The volume of water diverted from unregulated streams by licence holders in the Hopkins basin was 2,018 ML, which was lower than the 2015–16 volume of 2,458 ML (Table 6-157).

Table 6-157 Allocation account balance summary for the Hopkins basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Beaufort	419	0	164	255
Skipton (1)	210	0	0	210
Take and use licences - unregulated surface water	11,636	0	2,018	9,618
Total 2016–17	**12,265**	**0**	**2,182**	**10,083**
Total 2015–16	11,713	0	2,664	9,049

The estimated volume of water harvested from small catchment dams represents the largest diversion of water in the Hopkins basin (Table 6-158). The capacity of small catchment dams for Hopkins basin is estimated based on GIS mapping. The GIS data used to derive the capacity values for small catchment dams was updated in 2015–16, to provide a more-accurate measure.

Table 6-158 Estimated small catchment dam information for the Hopkins basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	28,278	14,139	n/a
Registered commercial and irrigation	8,699	7,307	n/a
Total	**36,977**	**21,446**	**39,196**

n/a Information not available.

6.24.3 Recycled water

Grampians Wimmera Mallee Water, Central Highlands Water and Wannon Water operate treatment plants within the Hopkins basin. Overall, 10% of wastewater was recycled in 2016–17, a slight decrease on 14% from 2015–16.

Table 6-159 shows the volumes and uses of recycled water in the Hopkins basin in 2016–17. Where water has been recycled within the plant process, this volume has not been included in the percent recycled value.

Table 6-159 Volume and use of recycled water in the Hopkins basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled (excludes within plant process)	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	679	424	61%	84	333	0	8	187	69
Beaufort	62	62	100%	0	62	0	0	0	0
Cardigan Village	0	0	0%	0	0	0	0	0	0
Mortlake	135	50	37%	2	47	0	0	86	0
Skipton	0	0	0%	0	0	0	0	0	0
Terang	319	125	39%	0	125	0	0	194	0
Warrnambool	5,728	122	1%	48	0	0	74	0	5,606
Willaura (1)	17	10	61%	10	0	0	0	12	(6)
Total 2016–17	**6,940**	**793**	**10%**	**144**	**567**	**0**	**82**	**479**	**5,669**
Total 2015–16	6,028	1,016	14%	207	657	0	153	0	5,012

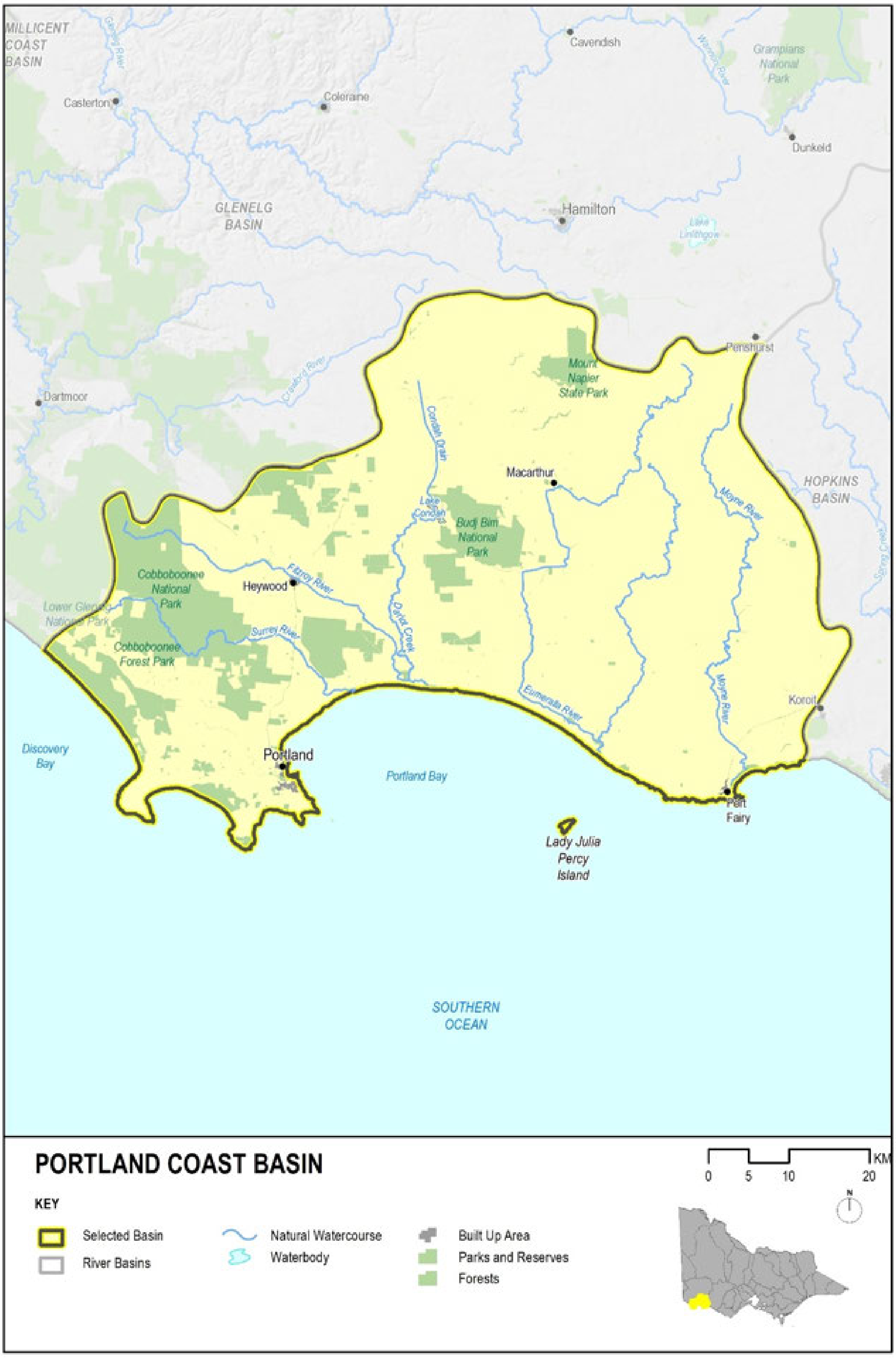
Note

(1) The negative volume for ‘Volume of other discharges (ML)’ indicates Grampians Wimmera Mallee Water have drawn water from a reclaimed water storage.

6.25 Portland Coast basin

The Portland Coast basin (Figure 6-48) is in south-west Victoria. Major rivers in the basin include the Moyne, Eumeralla, Fitzroy and Surrey rivers.

Figure 6-48 Map of the Portland Coast basin



6.25.1 Water resources overview

Rainfall throughout much of the Portland Coast basin in 2016–17 was between 100% and 125% of the long-term average.

Catchment inflows in 2016–17 were 140% of the long-term average, much higher than the 29% recorded in 2015–16. The amount of water flowing from the Portland Coast basin into Bass Strait represented 99% of the catchment inflows in the basin in 2016–17.

Licensed diversion bans were in place for licensed diversions in July 2016 on the Eumeralla, Surry, Moyne and Fitzroy rivers, and these bans were all lifted by August. The ban was reinstated on the Eumeralla River from January to February 2017 until it was lowered to stage 1 restrictions from March until June 2017.

No urban water use restrictions applied in the Portland Coast basin in 2016–17, with all towns remaining on permanent water-saving rules throughout the year.

Table 6-160 shows the responsibilities of the authorities within the Portland Coast basin.

Table 6-160 Responsibilities for water resources management in the Portland Coast basin

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Southern Rural Water	Manages licensed diversions		
Wannon Water		Supplies groundwater to Koroit, Port Fairy, Heywood and Portland	
Glenelg Hopkins Catchment Management Authority			Manages waterways in the whole Portland Coast basin

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 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 2016–17, 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.

6.25.2 Surface water resources

6.25.2.1 Water balance

The total volumes of water available and supplied from water resources in the Portland Coast basin in 2016–17 are shown in Table 6-161. Of the total inflows, about 1% were diverted for consumptive use, from small catchment dams. All towns serviced by Wannon Water in this basin are either supplied by groundwater or directly from other river basins. No storage information is recorded in the water balance as there are no major on-stream storages in the Portland Coast basin.

Table 6-161 Balance of surface water in the Portland Coast basin

Water account component	2016–17 (ML)	2015–16 (ML)
Major on-stream storage		
Volume in storage at start of year	-	-
Volume in storage at end of year	-	-
Change in storage	**0**	**0**
Inflows		
Catchment inflow (1)	505,276	104,323
Rainfall on major storages	-	-
Treated wastewater discharged back to river	277	98
Total inflows	**505,553**	**104,421**
Outflows		
Diversions		
Licensed diversions from unregulated streams	0	4

Small catchment dams	3,847	3,847
Total diversions	***3,848***	***3,851***
Losses		
Evaporation losses from major storages	-	-
Evaporation from small catchment dams	3,273	3,273
In-stream infiltration to groundwater, flows to floodplain and evaporation (2)	n/a	n/a
Total losses	***3,273***	***3,273***
Water passed at outlet of basin		
River outflows to the ocean	498,432	97,297
Total water passed at outlet of basin	***498,432***	***97,297***
Total outflows	**505,553**	**104,421**

Notes

(1) Catchment inflows is the balancing item in this water balance. It is the difference between the total outflows and the known inflows.

(2) No suitable model is available to make an estimate of in-stream losses.

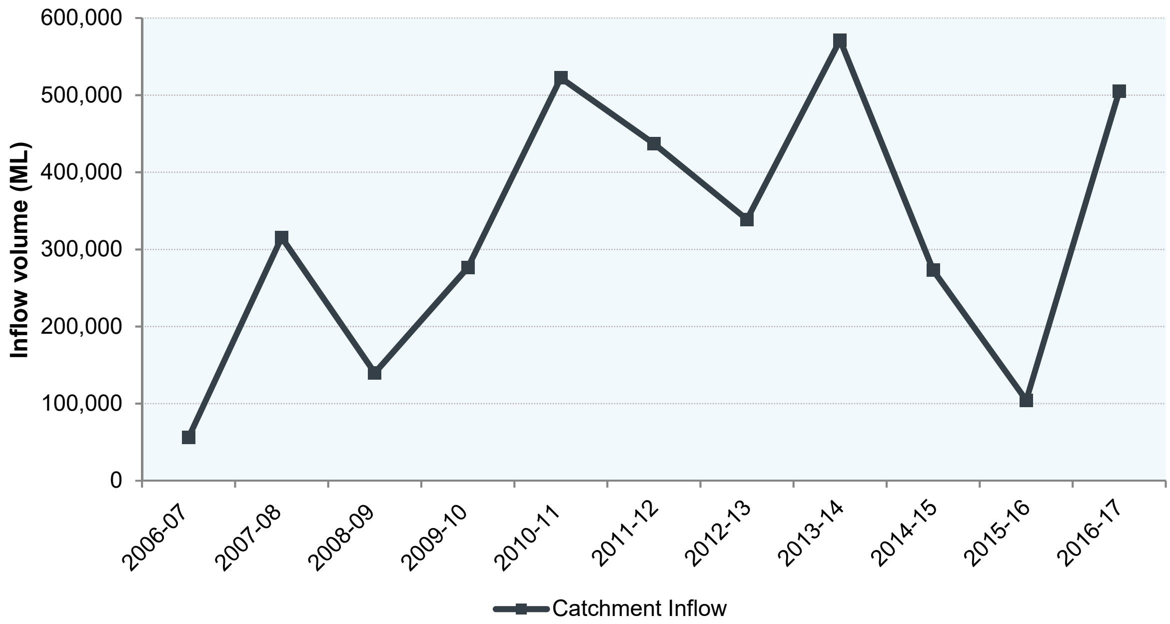
6.25.2.2 Storages and flows

There are no major storages in the Portland Coast basin.

Catchment inflows in 2016–17 were 505,276 ML or 140% of the long-term average of 361,000 ML, far greater than the 104,323 ML or 29% received in 2015–16 (Figure 6-49).

The amount of water flowing from the Portland Coast basin into Bass Strait was 498,432 ML in 2016–17, a significant increase from the previous year of 97,297 ML. This represents 99% of catchment inflows.

Figure 6-49 Catchment inflows in the Portland Coast basin



6.25.3 Entitlement volumes and diversions

In the Portland Coast basin, surface water is diverted from unregulated streams by licence holders and harvested in small catchment dams. No water corporations divert surface water in this basin.

Entitlements in Portland Coast include rights granted to individuals (take and use licences). Rights to water in the Portland Coast basin are outlined in Table 6-162.

Table 6-162 Entitlement volumes in the Portland Coast basin

Water entitlements	Annual entitlement volume (ML)
Take and use licences - unregulated surface water	1,078
Total volume of water entitlements in the Portland Coast basin	**1,078**

Allocation available under licences for 2016–17 is presented in Table 6-163. Unlike the previous year, no water was diverted for use in the basin in 2016–17.

Table 6-163 Allocation account balance summary for the Portland Coast basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Take and use licences - unregulated surface water	1,078	0	0	1,078
Total 2016–17	**1,078**	**0**		**1,078**
Total 2015–16	1,078	0	4	1,074

The estimated volume of water harvested from small catchment dams represents the largest diversion of surface water in the Portland Coast basin (Table 6-164). The capacity of small catchment dams for Portland Coast basin is estimated based on GIS mapping. The GIS data used to derive the capacity values for small catchment dams was updated in 2015–16, to provide a more-accurate measure.

Table 6-164 Estimated small catchment dam information for the Portland Coast basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	6,634	3,317	n/a
Registered commercial and irrigation	631	530	n/a
Total	**7,265**	**3,847**	**7,120**

n/a Information not available.

6.25.3 Recycled water

Wannon Water operates all treatment plants within the Portland Coast basin. Overall, 2% of wastewater was recycled in 2016–17, a slight decrease from 5% in 2015–16. Recycled water at the Heywood treatment plant was reused for wood-lot irrigation.

Table 6-165 shows the volumes and uses of recycled water in the Portland Coast basin in 2016–17. Where water has been recycled within the plant process, this volume has not been included in the percent recycled value.

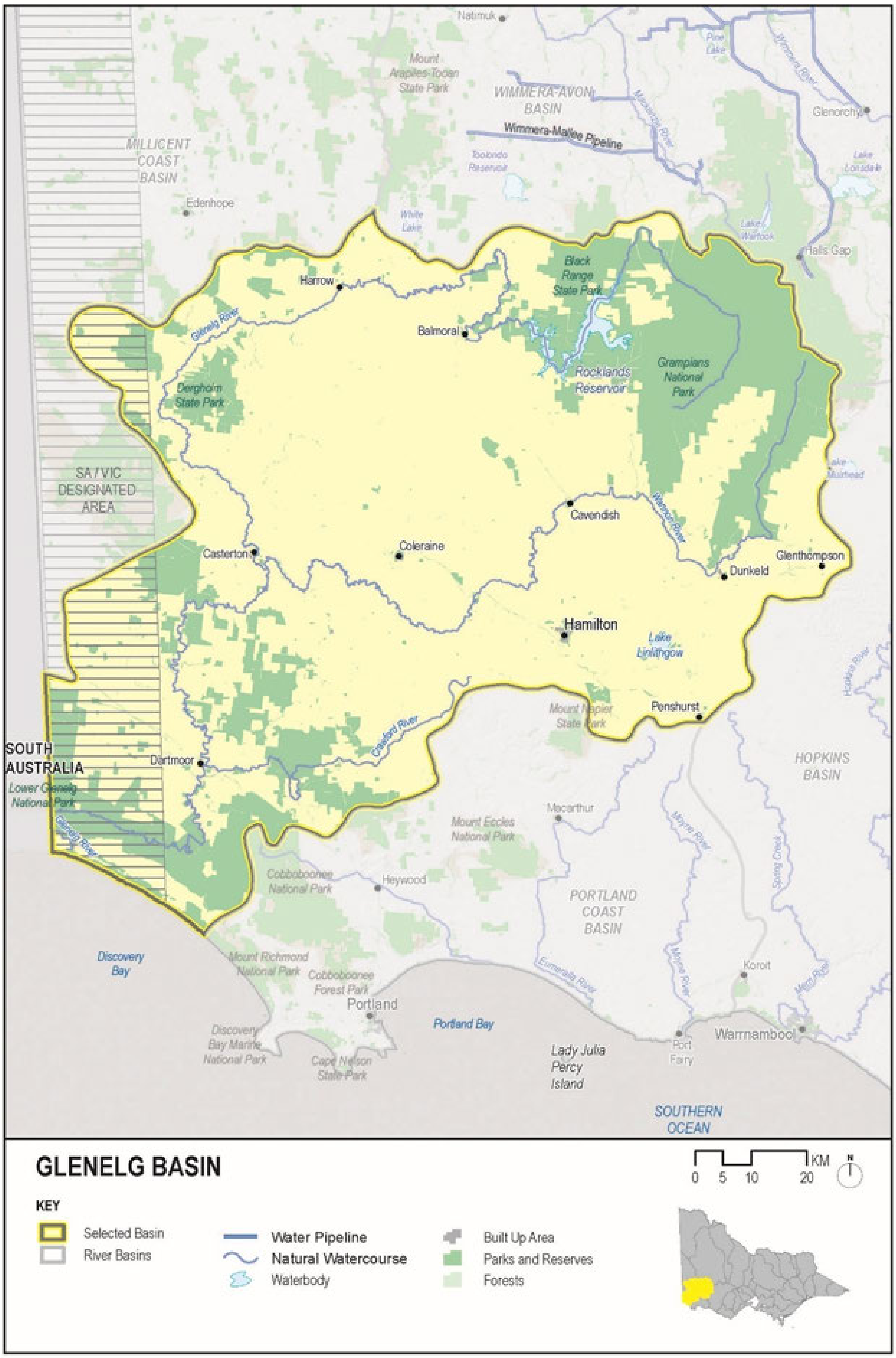
Table 6-165 Volume and use of recycled water in the Portland Coast basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled (excludes within plant process)	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	340	63	19%	0	63	0	0	277	0
Port Fairy Domestic	862	0	0%	0	0	0	0	0	862
Port Fairy Industrial	184	0	0%	0	0	0	0	0	184
Portland	1,498	0	0%	0	0	0	0	0	1,498
Total 2016–17	**2,884**	**63**	**2%**	**0**	**63**	**0**	**0**	**277**	**2,544**
Total 2015–16	2,285	120	5%	0	120	0	0	98	2,067

6.26 Glenelg basin

The Glenelg basin (Figure 6-50) is in the far west of Victoria. It has four on-stream storages, the largest of which is Rocklands Reservoir.

Figure 6-50 Map of the Glenelg basin



6.26.1 Water resources overview

Most of the Glenelg basin received between 125% and 150% of the long-term average rainfall in 2016–17, with an area in the southwestern half of the basin and a pocket to the north-east receiving between 100% 125% of the long-term average.

Catchment inflows in the Glenelg basin in 2016–17 were about 139% of the long-term average, a significant increase on 12% recorded in 2015–16. The basin's largest water storage, Rocklands Reservoir, started the year at 15% of capacity and was at 43% by the end of June 2017.

The Crawford, Glenelg, Grange Burn and Wannon rivers began the year with licensed diversion bans in July 2016, which were lifted by August. Bans resumed on the Wannon River from January to February 2017, and were then lowered to stage 1 restrictions from March to June.

Unlike the previous year, there were no urban restrictions applied in the Glenelg basin in 2016–17, with all towns in the basin remaining on permanent water-saving rules throughout the year.

Table 6-166 shows the responsibilities of the authorities within the Glenelg basin.

Table 6-166 Responsibilities for water resources management in the Glenelg basin

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
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 Obliged to meet passing flow requirements
Wannon Water		Supplies all other towns in the basin	Operates reservoirs in the Hamilton supply system Obliged to meet passing flow requirements
Victorian Environmental Water Holder			Holds and manages entitlements for the environment in the basin
Glenelg Hopkins Catchment Management Authority			Manages waterways in the Glenelg basin

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 2016–17, 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 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 2016–17, a total of 2,765 ML of environmental water was used in the Glenelg basin. This was all delivered in-stream for the Glenelg River.

6.26.2 Surface water resources

6.26.2.1 Water balance

The total volumes of water available and supplied from water resources in the Glenelg basin in 2016–17 are shown in Table 6-167. A volume of 12,870 ML was diverted to the Wimmera system in 2016–17.

The volume of water flowing from the Glenelg basin into Bass Strait was 1,036,754 ML in 2016–17, which is significantly more than the previous year when 55,089 ML flowed out of the basin (Table 6-167).

Table 6-167 Balance of surface water in the Glenelg basin

Water account component	2016–17 (ML)	2015–16 (ML)
Major on-stream storage		
Volume in storage at start of year	48,165	62,675
Volume in storage at end of year	134,014	48,165
Change in storage	**85,849**	**(14,510)**
Inflows		
Catchment inflow (1)	1,336,754	116,795
Rainfall on major storages	25,797	7,625
Treated wastewater discharged back to river	604	0
Total inflows	**1,363,155**	**124,420**
Outflows		
Diversions		
Urban diversions	1,776	1,743
Transfers to the Wimmera basin (2)	12,870	14,576
Licensed diversions from unregulated streams	50	74
Small catchment dams	18,899	18,899
Total diversions	***33,595***	***35,292***
Losses		
Evaporation losses from major storages	26,752	19,603
Losses from small catchment dams	19,024	19,024
In-stream infiltration to groundwater, flows to floodplain and evaporation	161,180	9,921
Total losses	***206,957***	***48,548***
Water passed at outlet of basin		
River outflows to the ocean	1,036,754	55,089
Total water passed at outlet of basin	***1,036,754***	***55,089***
Total outflows	**1,277,306**	**138,930**

Notes

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

(2) Transfers from the Glenelg basin to the Brimpaen storages in the Wimmera basin, via the Moora Channel, Wannon Creek and transfer from Rocklands Reservoir via Rocklands Channel.

6.26.2.2 Storages and flows

Four major storages are located within the basin. Rocklands Reservoir, which accounts for 97% of the total capacity of Glenelg basin storages, was holding 43% of its storage capacity at the end of 2016–17. The volume reported in the 'Catchment inflows less regulated releases' column of Table 6-168 is the balancing item for each storage. It represents the flows of water in or out of the storage that are not shown as rainfall or evaporation, and may include other minor components influencing the change in storage during the year.

Table 6-168 Storage volumes in the Glenelg basin

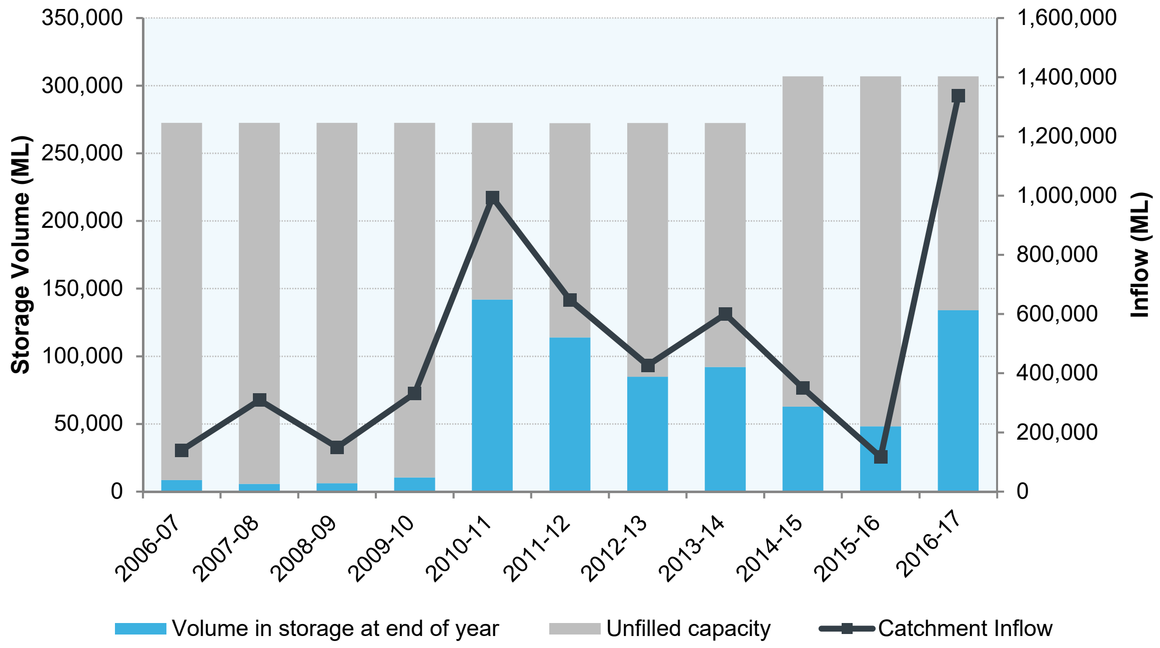
Storage	Total capacity (ML) (1)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Hamilton system reservoirs	2,654	1,780	342	85	(59)	1,978
Konongwootong Reservoir	1,920	1,415	562	140	(11)	1,826
Moora Moora Reservoir	6,300	906	3,085	3,000	2,819	3,810
Rocklands Reservoir	296,000	44,065	21,808	23,527	84,054	126,400
Total storage volumes	**306,874**	**48,165**	**25,797**	**26,752**	**86,803**	**134,014**

Note

(1) Volumes shown are the maximum operating capacities of storages.

Catchment inflows across the basin were 1,336,754 ML. This was 139% of the long-term average of 964,000 ML, much higher than the 116,794 ML recorded in 2015–16 (Figure 6-51).

Figure 6-51 Storage volumes and catchment inflows in the Glenelg basin



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6.26.2.3 Entitlement volumes and diversions

In the Glenelg basin, bulk entitlements to surface water are held by Grampians Wimmera Mallee Water, Central Highlands Water, Coliban Water and Wannon Water. Surface water is also diverted by licensed diverters, and surface water is harvested in small catchment dams.

Entitlements include rights granted to individuals (take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations or environmental entitlements granted to the VEWH). Rights to water in the Glenelg basin are outlined in Table 6-169.

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 also supplies 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. Therefore, the entitlement volumes and diversions are presented in the Wimmera basin chapter in Table 6-181.

Wannon Water also holds four other bulk entitlements for supply to towns within the Glenelg basin, shown in Table 6-169.

Table 6-169 Entitlement volumes in the Glenelg basin

Water entitlements	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 volume of water entitlements in Glenelg basin	**5,598**

Allocation available under bulk entitlements and licences for 2016–17 is presented in Table 6-170.

The volume of water diverted from unregulated streams by licence holders in the Glenelg basin in 2016–17 was lower than the volume (74 ML) reported in the *Victorian Water Accounts 2015–16*.

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. The allocation available for use under this entitlement for 2016–17 is presented in the Wimmera basin chapter in Table 6-181.

Table 6-170 Allocation account balance summary for the Glenelg basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Coleraine, Casterton, Sandford	855	0	134	721
Dunkeld System	170	0	63	107
Glenthompson	94	0	0	94
Hamilton	3,435	0	1,579	1,856
Take and use licences - unregulated surface water	1,046	0	50	996
Total 2016–17	**5,600**	**0**	**1,826**	**3,774**
Total 2015–16	5,598	0	1,817	3,781

The estimated volume of water harvested from small catchment dams makes up a significant portion of total surface water diversions in the Glenelg basin (Table 6-171). The capacity of small catchment dams for Glenelg basin is estimated based on GIS mapping. The GIS data used to derive the capacity values for small catchment dams was updated in 2015–16, to provide a more-accurate measure.

Table 6-171 Estimated small catchment dam information for the Glenelg basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	34,504	17,252	n/a
Registered commercial and irrigation	1,961	1,647	n/a
Total	**36,465**	**18,899**	**37,924**

n/a Information not available.

6.26.3 Recycled water

Wannon Water operates all treatment plants within the Glenelg basin. Overall, 51% of wastewater was recycled in 2016–17, almost half of the volume recycled in 2015–16.

Table 6-172 shows the volumes and uses of recycled water in the Glenelg basin in 2016–17. Where water has been recycled within the plant process, this volume has not been included in the percent recycled value.

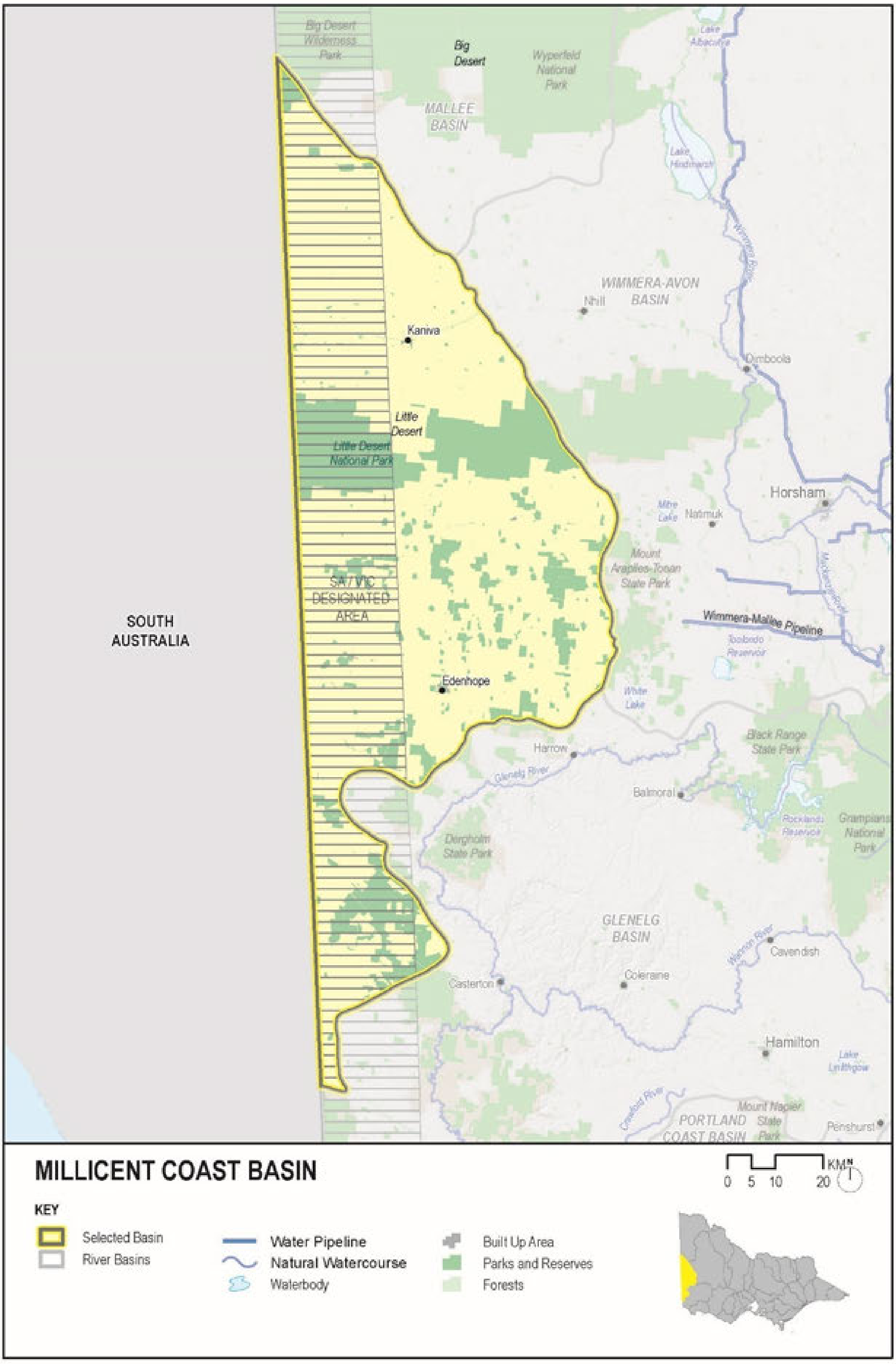
Table 6-172 Volume and use of recycled water in the Glenelg basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled (excludes within plant process)	Type of end use (ML)				Volume discharged to the environment	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Casterton	111	50	45%	0	50	0	0	60	0
Coleraine	15	15	100%	0	15	0	0	0	0
Dunkeld	37	16	44%	16	0	0	0	21	0
Hamilton	1,074	550	51%	60	491	0	0	523	0
Total 2016–17	**1,237**	**631**	**51%**	**76**	**556**	**0**	**0**	**604**	**0**
Total 2015–16	746	746	100%	154	592	0	0	0	0

6.27 Millicent Coast basin

The Millicent Coast basin (Figure 6-52) 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 6-52 Map of the Millicent Coast basin



6.27.1 Water resources overview

In 2016–17, rainfall throughout the southern half of the Millicent Coast basin was between 125% and 150% of the long-term average, with the northern half receiving between 100% to 125%.

Groundwater is the main source of water supply in the Millicent Coast basin and this is covered by the West Wimmera groundwater management area. 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 2016–17, with all towns remaining on permanent water-saving rules throughout the year.

Table 6-173 shows the responsibilities of the authorities within the Millicent Coast basin.

Table 6-173 Responsibilities for water resources management in the Millicent Coast basin

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Grampians Wimmera Mallee Water	Manages licensed diversions in the Millicent Coast basin	Supplies all towns including Kaniva and Edenhope	
Wimmera Catchment Management Authority			Manages waterways in the whole of the Millicent Coast basin

Water for the environment

The Millicent Coast basin contains numerous wetlands that depend on water. 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 2016–17, 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.

6.27.2 Surface water resources

6.27.2.1 Water balance

Limited information is currently available for surface water availability and use, so a water balance has not been included for the Millicent Coast basin.

6.27.2.2 Storages and flows

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. Any surface water not diverted flows to South Australia.

6.27.2.3 Entitlement volume and diversions

There are no bulk entitlements to surface water in the Millicent Coast basin. Any water diverted is from unregulated streams under licences. At the end of 2016–17, the licensed volume totalled 4 ML and use was estimated to be 4 ML.

Entitlements in Millicent Coast include rights granted to individuals (take and use licences). Rights to water in the Millicent Coast basin are outlined in Table 6-174.

Table 6-174 Entitlement volumes in the Millicent Coast basin

Water entitlements	Annual entitlement volume (ML)
Take and use licences - unregulated surface water	4
Total volume of water entitlements in the Millicent Coast basin	**4**

Allocation available under licences in the Millicent Coast basin for 2016–17 is presented in Table 6-175.

Table 6-175 Allocation account balance summary for the Millicent Coast basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Take and use licences - unregulated surface water	4	0	4	0
Total 2016–17	**4**	**0**	**4**	**0**
Total 2015–16	25,593	0	11,612	13,981

The estimated volume of water harvested from small catchment dams makes up a significant portion of total surface water diversions in the Millicent Coast basin (Table 6-176). In previous years, information was not readily available within the Millicent Coast basin and therefore not reported on. The GIS data used to derive the capacity values for small catchment dams was updated in 2015–16, to provide a more-accurate measure.

Table 6-176 Estimated small catchment dam information for the Millicent Coast basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	1,789	895	n/a
Registered commercial and irrigation	5,612	4,714	n/a
Total	**7,401**	**5,609**	**8,067**

n/a Information not available.

6.27.3 Recycled water

Grampians Wimmera Mallee Water operates wastewater treatment plants within the Millicent Coast basin. About 36% of wastewater was recycled in 2016–17, a decrease from the previous year's 100%. Wastewater from Edenhope was reused for a variety of urban and industrial purposes including pasture improvement and watering recreational facilities and parks. Because the wastewater produced at Kaniva and Serviceton treatment plants was evaporated on-site in 2015–16, it was not included in the table.

Table 6-177 shows the volumes and uses of recycled water in the Millicent Coast basin in 2016–17. Where water has been recycled within the plant process, this volume has not been included in the percent recycled value.

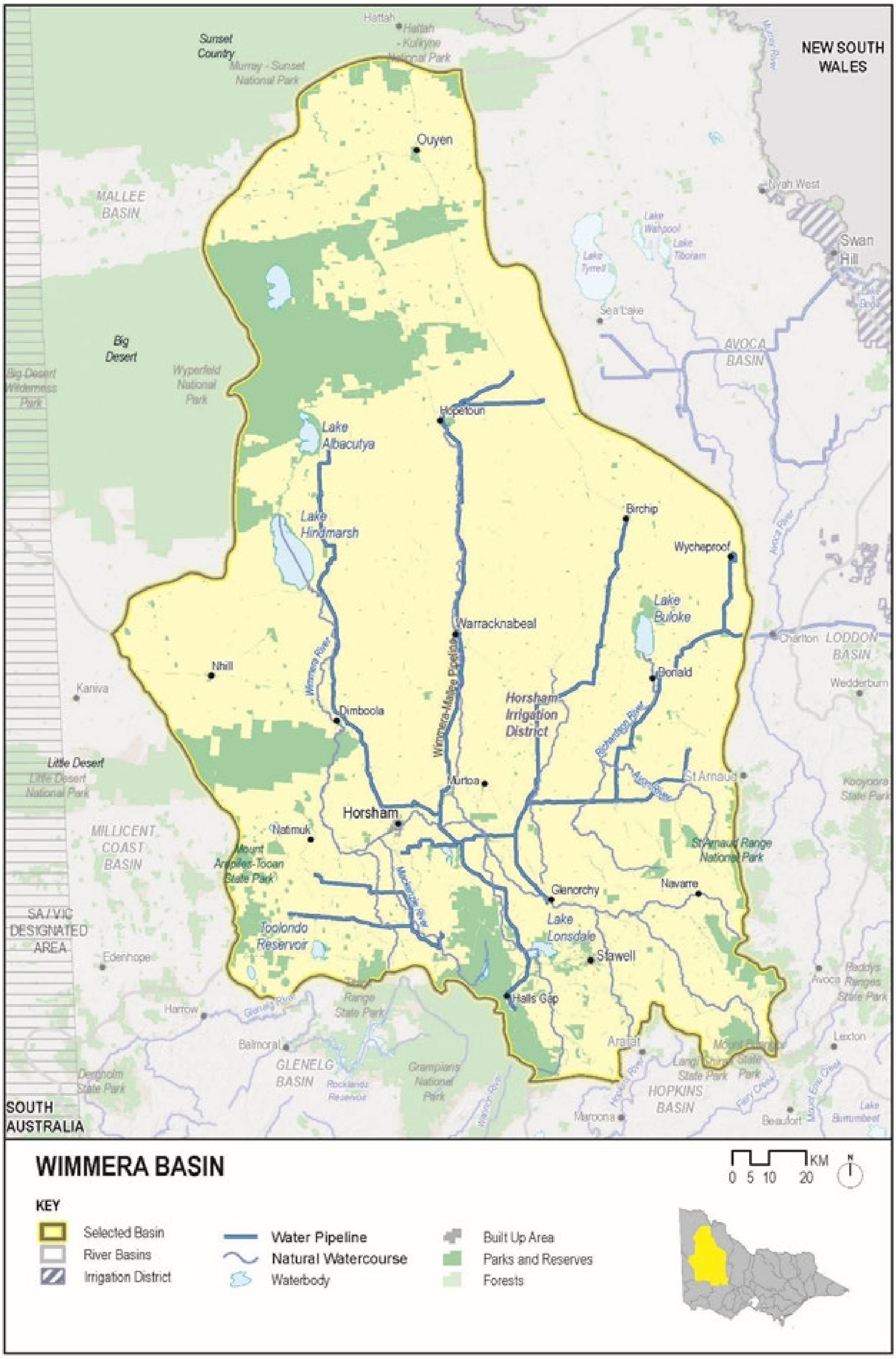
Table 6-177 Volume and use of recycled water in the Millicent Coast basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled (excludes within plant process)	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	77	38	49%	38	0	0	0	0	39
Kaniva North	5	0	0%	0	0	0	0	0	5
Kaniva South	18	0	0%	0	0	0	0	0	18
Serviceton	6	0	0%	0	0	0	0	0	6
Total 2016–17	**106**	**38**	**36%**	**38**	**0**	**0**	**0**	**0**	**68**
Total 2015–16	36	36	100%	36	0	0	0	0	0

6.28 Wimmera basin

The Wimmera basin (Figure 6-53) is the largest landlocked river basin in Victoria. The Wimmera River's headwaters are near Mt Cole in the Pyrenees Ranges. It 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 6-53 Map of the Wimmera basin



6.28.1 Water resources overview

In 2016–17, rainfall across the Wimmera basin was above average: it was between 125% and 150% of the long-term average. The southern half of the basin and a small pocket in the north-east received 100% to 125% of the long-term average.

Catchment inflows in the Wimmera basin in 2016–17 were 110% of the long-term average, a major increase on the 14% recorded in 2015–16.

Storage levels in the Wimmera basin started the year at 26% and ended the year at 50% of total capacity.

Aside from the licensed diversion ban in July 2016 and restrictions in August, above-average rainfall meant that the Wimmera River remained unrestricted for the remainder of 2016–17.

Unlike the previous year, there were no urban restrictions applied within the Wimmera basin in 2016–17, with all towns in the basin remaining on permanent water-saving rules throughout the year.

Table 6-178 shows the responsibilities of the authorities within the Wimmera basin.

Table 6-178 Responsibilities for water resources management in the Wimmera basin

Authority	Irrigation and rural water supply	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
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 Obliged to meet passing flow requirements
Central Highlands Water			Supplies Landsborough and Navarre	Obliged to meet passing flow requirements
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			
Victorian Environmental Water Holder				Holds and manages entitlements for the environment in the basin
Wimmera Catchment Management Authority				Manages waterways in the Wimmera River catchment
North Central Catchment Management Authority				Manages waterways in the east of the basin, including the Avon and Richardson rivers

Note
(1) Also supplies farms and towns located in the Avoca and Mallee basins.

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*; 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 2016–17, water for the environment in the Wimmera basin contained:

- 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 Commonwealth Environmental Water Holder 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 13,585 ML of environmental water was used in the Wimmera basin in 2016–17; 119 ML of this was diverted off-stream while the remaining water was delivered in-stream.

6.28.2 Surface water resources

6.28.2.1 Water balance

The total volumes of water available and supplied from water resources in the Wimmera basin in 2016–17 are shown in Table 6-179.

Table 6-179 Balance of surface water in the Wimmera basin

Water account component	2016–17 (ML)	2015–16 (ML)
Major on-stream storage		
Volume in storage at start of year	85,800	102,464
Volume in storage at end of year	169,205	85,800
Change in storage	**83,405**	**(16,664)**
Inflows		
Catchment inflow (1)	347,538	44,378
Rainfall on major storages	32,114	11,445
Transfer from Glenelg basin	12,870	14,576
Treated wastewater discharged back to river	335	0
Total inflows	**392,856**	**70,399**
Outflows		
Diversions		
Urban diversions and domestic and stock use	12,763	16,462
Diversions for irrigation	0	0
Licensed diversions from unregulated streams	166	387
Environmental water diversions to wetlands (2)	119	142
Supply to designated recreational lakes (3)	1,275	2,504
Small catchment dams	18,310	18,310
Total diversions	***32,633***	***37,805***
Losses		
Evaporation losses from major storages	46,678	29,973
Evaporation from small catchment dams	14,099	14,099
In-stream infiltration to groundwater, flows to floodplain and evaporation	24,288	2,040
Total losses	***85,064***	***46,112***
Water passed at outlet of basin		
River outflows to Lake Buloke	36,066	0
River outflows to Lake Hindmarsh (measured at Tarranyurk)	155,687	3,146
Total water passed at outlet of basin	***191,753***	***3,146***
Total outflows	**309,451**	**87,063**

Notes

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

(2) The *Environmental Entitlement (Wimmera and Glenelg Rivers) 2010* provides the VEWH with up to 1,000 ML for wetlands 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.

(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.

6.28.2.2 Storages and flows

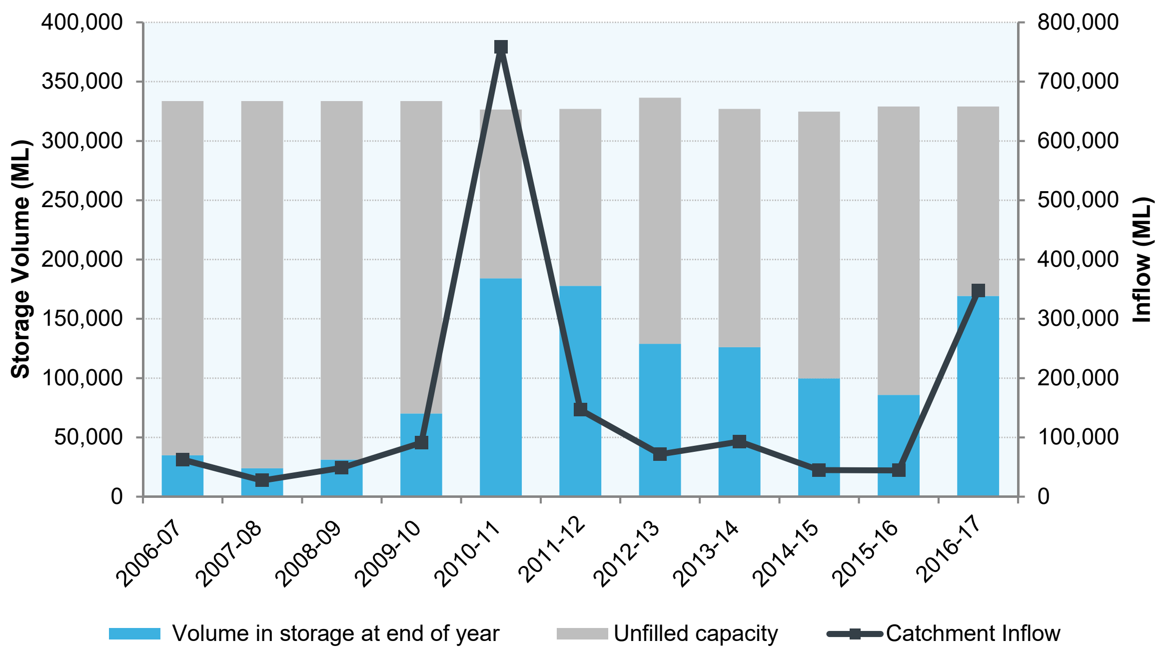
Levels for all major storages in the basin started the year at 85,800 ML and finished at 169,205 ML (50% of capacity) at the end of June 2017 (Table 6-180). The volume reported in the 'Catchment inflows less regulated releases' column in Table 6-180 is the balancing item for each storage. It represents the flows of water in or out of the storage that are not shown as rainfall or evaporation, and may include other minor components influencing the change in storage during the year.

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	9,804	2,158	3,918	5,794	13,838
Green Lake	5,350	474	780	2,131	2,928	3,402
Lake Bellfield	78,560	43,965	4,190	3,185	18,835	63,805
Lake Lonsdale	53,300	0	9,542	18,435	41,743	32,850
Taylors Lake	27,060	12,547	1,975	4,696	10,744	20,570
Toolondo Reservoir	50,533	3,380	3,954	7,583	13,744	13,495
Wartook Reservoir	29,300	15,630	9,515	6,730	2,830	21,245
Total storage volumes	**328,983**	**85,800**	**32,114**	**46,678**	**96,618**	**169,205**

Catchment inflows were 347,538 ML or 110% of the long-term average of 316,400 ML. This a major increase on the 44,236 ML or 14% recorded in 2015–16 (Figure 6-54). The volume of water flowing from the Wimmera basin into the terminal lakes in 2016–17 was 191,753 ML.

Figure 6-54 Storage volumes and catchment inflows in the Wimmera basin (1)



Note

(1) In earlier editions of the Victorian Water Accounts, the full capacities of Lake Lonsdale (65,480 ML) and Toolondo Reservoir (92,430 ML) were reported. The *Victorian Water Accounts 2015–16* use the operating capacities of these reservoirs.

6.28.2.3 Entitlement volumes and diversions

In the Wimmera basin, surface water is diverted by Central Highlands Water, Coliban Water, Grampians Wimmera Mallee Water, Wannon Water and licensed diverters, and is also harvested in small catchment dams. Entitlements in the Wimmera basin include rights granted to individuals (for example, water allowances and take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations or environmental entitlements granted to the VEWH). Rights to water in the Wimmera basin are outlined in Table 6-181.

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.

Table 6-181 Entitlement volumes in the Wimmera basin

Water entitlements	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 - GWMWater	408
Bulk Entitlement (Willaura system - Wannon Water) Conversion Order 2012	58
Sub-total: Bulk Entitlement (Willaura, Elmhurst and Buangor systems - GWMWater) Conversion Order 2012	**466**
Bulk Entitlement (Wimmera and Glenelg Rivers - GWMWater) Conversion Order 2010 (2)	
Water allowances	6,347
Urban commitments - GWMWater	26,373
Supply by agreements - Pipeline	12,000
Supply by agreement - CEWH	28,000
Glenelg compensation flow	3,300
Recreation	3,090
Pipeline loss provision	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 (3)	41,560
Sub-total: Bulk Entitlement (Wimmera and Glenelg Rivers - GWMWater) Conversion Order 2010	**126,050**
Take and use licences - unregulated surface water (4)	2,228
Total volume of water entitlements in the Wimmera basin	**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 CEWH.

(3) This entitlement provides the VEWH with a 40,560 ML entitlement for rivers in the Wimmera and Glenelg basins and an entitlement of 1,000 ML for wetlands in the Wimmera and Mallee basins supplied via the Wimmera Mallee Pipeline. The 1,000 ML entitlement supplies water to wetlands in the region that historically received water from the channel system before it was decommissioned.

(4) The total volume of licences in the Wimmera basin includes licences for irrigation as well as for domestic and stock purposes.

Allocation available under bulk entitlements and licences for 2016–17 is presented in Table 6-182. There were no irrigation diversions from unregulated streams in 2016–17; the diversion reported is an estimate of licensed domestic and stock use.

Table 6-182 Allocation account balance summary for the Wimmera basin

Water entitlement	Opening carryover (ML)	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)	Carryover carried forward (ML)
Landsborough - Navarre	-	60	0	0	60	-
Willaura, Elmhurst and Buangor systems - GWMWater						
Urban commitments - GWMWater	-	408	0	137	271	-
Willaura system - Wannon Water	-	58	0	40	18	-
Diversion: Willaura, Elmhurst and Buangor systems - GWMWater				**177**		
Wimmera and Glenelg Rivers - GWMWater						
Water allowances	-	6,333	15	1,293	5,055	-
Urban commitments - GWMWater (1)	54,749	32,714	(2,749)	10,328	8,007	66,378
Supply by agreements – Pipeline	12,931	12,000	(5,000)	12	7,228	12,692
Supply by agreement - CEWH	0	14,280	0	0	2,142	12,138
Glenelg compensation flow	24	3,300	0	0	499	2,826
Recreation (1)	0	3,090	2,500	1,275	647	3,668
Pipeline loss provision	5,340	2,960	0	717	1,137	6,445
Wimmera and Glenelg Rivers - Coliban Water	91	300	250	197	66	378
Wimmera and Glenelg Rivers - Wannon Water	4,368	2,120	0	39	968	5,481
Wimmera and Glenelg Rivers Environmental Entitlement (2)	7,022	41,560	5,000	13,585	6,000	33,997
Diversion: Wimmera and Glenelg Rivers (3)				**27,446**		
Take and use licences - unregulated surface water	-	2,232	0	166	2,066	-
Total 2016–17	**84,525**	**121,415**	**16**	**27,789**	**34,164**	**144,003**

Total 2015–16	111,303	26,096	0	27,607	25,408	84,525

Notes

(1) In 2016–17, Grampians Wimmera Mallee Water traded 2,500 ML from its urban commitments to its recreation entitlement to support the supply of water to the 10 nominated recreation lakes.

(2) Use against this environmental entitlement included 13,466 ML of water delivered instream — 10,701 ML in the Wimmera basin and 2765 ML in the Glenelg basin — and 119 ML of water delivered off-stream to the Wimmera Mallee wetlands. The 10,701 ML delivered instream 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.

(3) 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; 13,466 ML of water delivered in-stream in the Wimmera and Glenelg basins is not included as a diversion in the water balance in Table 6-178 above.

The estimated volume of water harvested from small catchment dams makes up a significant portion of total surface water diversions in the Wimmera basin (Table 6-183). The capacity of small catchment dams for Wimmera basin is estimated based on GIS mapping. The GIS data used to derive the capacity values for small catchment dams was updated in 2015–16, to provide a more-accurate measure.

Table 6-183 Estimated small catchment dam information for the Wimmera basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	23,883	11,942	n/a
Registered commercial and irrigation	7,582	6,369	n/a
Total	**31,465**	**18,310**	**32,409**

n/a Information not available.

6.28.3 Recycled water

Grampians Wimmera Mallee Water operates all treatment plants within the Wimmera basin. Unlike in 2015–16 when all wastewater was recycled, only 64% of wastewater was recycled in 2016–17. The wastewater produced within the basin was reused for irrigating pasture, horticulture and vineyards, and it was also used for urban and industrial purposes.

Table 6-184 shows the volumes and uses of recycled water in the Wimmera basin in 2016–17. Where water has been recycled within the plant process, this volume has not been included in the percent recycled value.

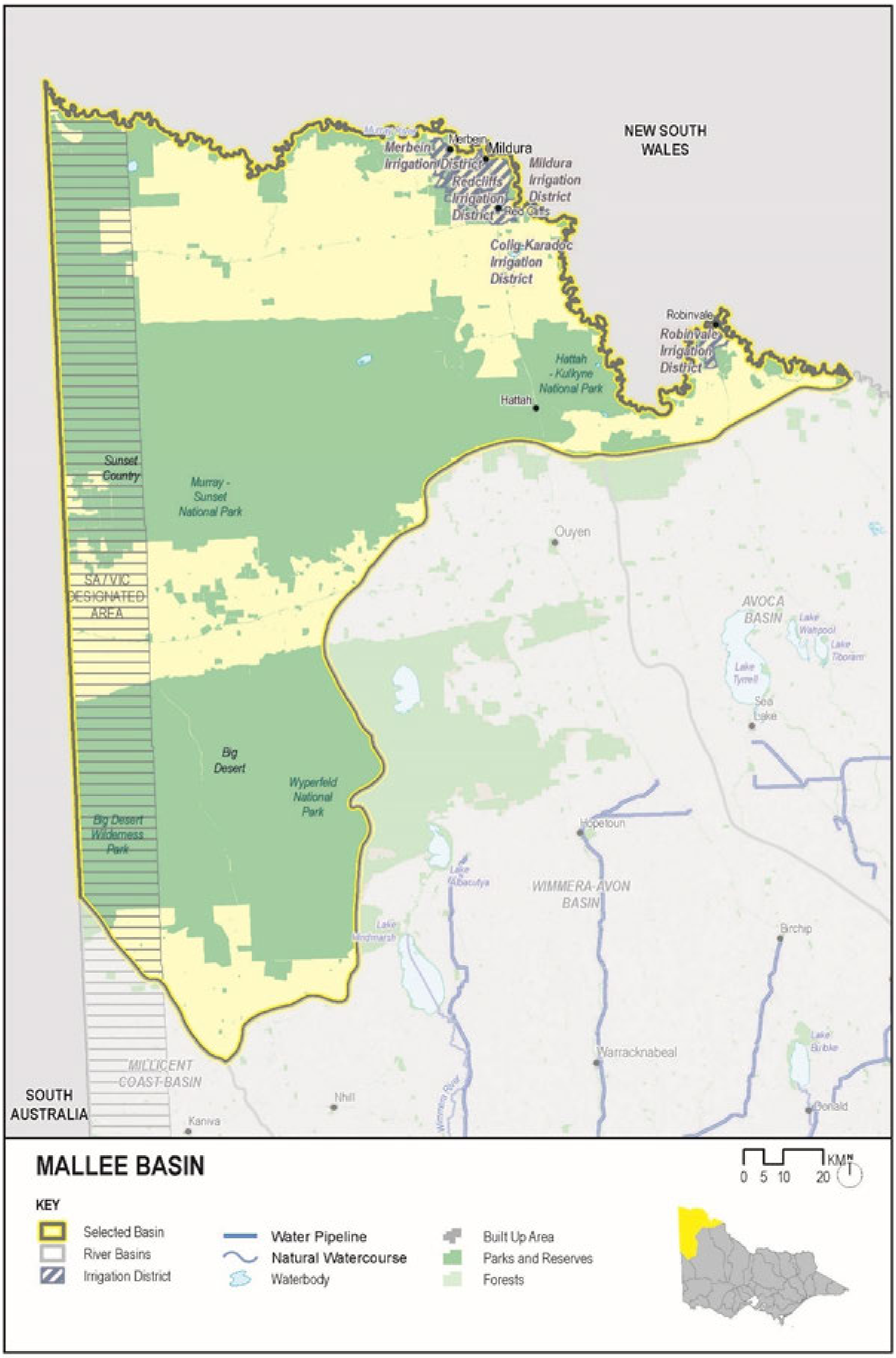
Table 6-184 Volume and use of recycled water in the Wimmera basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled (excludes within plant process)	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	42	30	71%	0	30	0	0	0	12
Dimboola	99	0	0%	0	0	0	0	0	99
Donald	122	95	78%	0	95	0	0	0	27
Halls Gap	165	68	41%	9	60	0	0	27	70
Hopetoun	15	0	0%	0	0	0	0	0	15
Horsham	1,060	663	63%	120	543	0	0	238	159
Jeparit	28	0	0%	0	0	0	0	0	28
Minyip	17	0	0%	0	0	0	0	0	17
Murtoa	58	42	72%	0	42	0	0	0	16
Natimuk	14	0	0%	0	0	0	0	0	14
Nhill	124	113	91%	0	113	0	0	0	12
Ouyen	70	0	0%	0	0	0	0	0	70
Rainbow	34	0	0%	0	0	0	0	0	34
Rupanyup	17	0	0%	0	0	0	0	0	17
Stawell	541	543	100%	166	378	0	0	52	(54)
Warracknabeal	191	90	47%	90	0	0	0	18	83
Wycheproof	41	41	100%	0	41	0	0	0	0
Total 2016–17	**2,638**	**1,685**	**64%**	**385**	**1,302**	**0**	**0**	**335**	**619**
Total 2015–16	1,457	1,457	100%	470	985	0	0	0	0

6.29 Mallee basin

The Mallee basin (Figure 6-55) 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 6-55 Map of the Mallee basin



6.29.1 Water resources overview

In 2016–17, most of the Mallee basin received above-average rainfall with between 100% and 125% of long-term average rainfall received in the north and south and a large area in the centre receiving between 125% and 150%.

Almost all surface water used in the Mallee basin is sourced from other basins.

Between July and August 2016, there was a licensed diversion ban on the Avoca River.

No urban water use restrictions applied in the Mallee basin in 2016–17, with all towns remaining on permanent water-saving rules throughout the year.

Table 6-185 shows the responsibilities of the authorities within the Mallee basin.

Table 6-185 Responsibilities for water resources management in the Mallee basin

Authority	Irrigation and rural water supply	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
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				Manages waterways in the whole Mallee basin

Water for the environment

In 2016–17, 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.

6.29.2 Surface water resources

6.29.2.1 Water balance

A water balance for the Mallee basin has not been presented. All surface water supplies are sourced from outside the basin.

6.29.2.2 Storages and flows

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.

6.29.2.3 Entitlement volumes and diversions

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.

6.29.4 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.

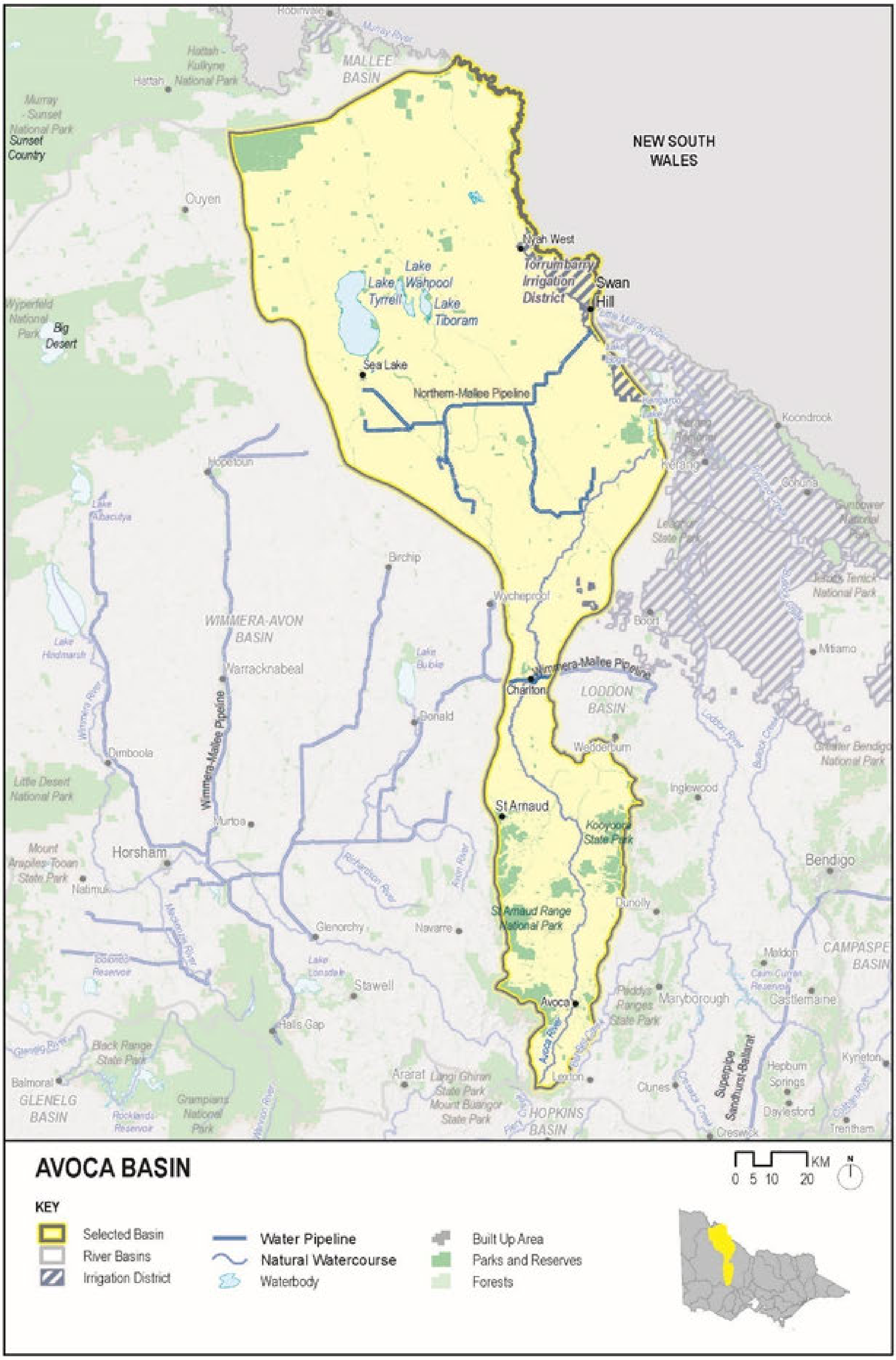
6.29.3 Recycled water

There are no wastewater treatment plants within the Mallee basin.

6.30 Avoca basin

The Avoca basin (Figure 6-56) 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 6-56 Map of the Avoca basin



6.30.1 Water resources overview

Rainfall across the centre of the Avoca basin in 2016–17 was between 125% and 150% of the long-term average, with part of the north and the area south of Charlton receiving between 100% and 125% of average rainfall.

Catchment inflows were 46% of the long-term average of 136,200 ML, which is higher than the 13% reported in 2015–16. Unlike the previous year where no water reached the terminal lakes in the north of the basin, in 2016–17 37,894 ML of outflows was recorded.

Between July and August 2016, there was a licensed diversion ban in place on the Avoca River. Towns in the Avoca basin are mainly supplied by groundwater or by surface water from the Wimmera, Glenelg and Murray basins. Therefore, only a limited volume of surface water from within the basin is used for urban supply. There were no urban restrictions applied within the Avoca basin in 2016–17, with all towns in the basin remaining on permanent water-saving rules throughout the year.

Table 6-186 shows the responsibilities of the authorities within the Avoca basin.

Table 6-186 Responsibilities for water resources management in the Avoca basin

Authority	Irrigation and rural water supply	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Central Highlands Water			Supplies towns in the southern part of the Avoca basin including Avoca and Redbank	Obliged to meet passing flow requirements
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 (1)	
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 CMA				Manages waterways in the Avoca basin

Note

(1) Water for these towns is sourced from outside the Avoca basin.

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 2016–17, 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.

6.30.2 Surface water resources

6.30.2.1 Water balance

The total volumes of water available and supplied from water resources in the Avoca basin in 2016–17 are shown in Table 6-187. No storage information is recorded in the water balance as there are no major on-stream storages in the Avoca basin.

Of the total inflows, about 16% were diverted for consumptive use, mainly from small catchment dams. There were no licensed diversions in 2016–17. Urban diversion volumes were similar to 2015–16 volumes and represent a small proportion of the total water consumption in the basin. Although overall usage volumes were similar to 2015–16, significantly higher volumes of surface water were available in 2016–17, compared to 2015–16 (Table 6-187).

Table 6-187 Balance of surface water in the Avoca basin

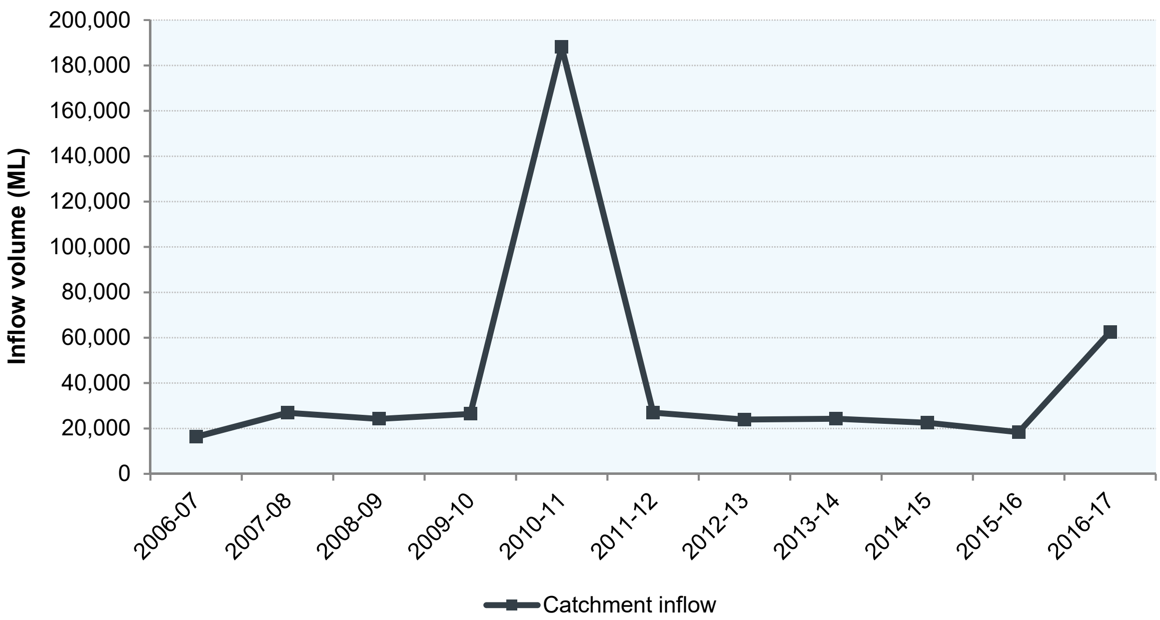
Water account component	2016–17 (ML)	2015–16 (ML)
Major on-stream storage		
Volume in storage at start of year	-	-
Volume in storage at end of year	-	-
Change in storage	**-**	**-**
Inflows		
Catchment inflow (1)	62,597	18,377
Rainfall on major storages	-	-
Treated wastewater discharged back to river	94	0
Total inflows	**62,691**	**18,377**
Outflows		
Diversions		
Urban diversions	31	23
Licensed diversions from unregulated streams	40	40
Small catchment dams	9,765	9,765
Total diversions	***9,836***	***9,828***
Losses		
Evaporation losses from major storages	-	-
Evaporation from small catchment dams	8,549	8,549
In-stream infiltration to groundwater, flows to floodplain and evaporation (2)	6,413	0
Total losses	***14,962***	***8,549***
Water passed at outlet of basin		
Avoca River flow at Sandhill Lake Road (outflow to terminal lakes)	37,894	0
Avoca River overflow from the terminal lakes to the Kerang Lakes	0	0
Total water passed at outlet of basin	***37,894***	***0***
Total outflows	**62,691**	**18,377**

Notes
(1) Catchment inflows is the balancing item in this water balance. It is the difference between the total outflows and the known inflows.
(2) In-stream infiltration not available due to poor-quality water flow data in 2015–16.

6.30.2.2 Storages and flows

In 2016–17, catchment inflows were 62,558 ML or 46% of the long-term average of 136,200 ML, which is much higher than the 13% received in 2015–16 (Figure 6-57). Unlike the previous year, above-average rainfall meant that 37,894 ML flowed into the terminal lakes (Lake Bael Bael and The Marsh). This represents 61% of the catchment inflows. No storage information is shown in Figure 6-57, because there are no major storages in the Avoca basin.

Figure 6-57 Catchment inflows in the Avoca basin



6.30.2.3 Entitlement volumes and diversions

In the Avoca basin, water is diverted by Central Highlands Water and licensed diverters, and harvested in small catchment dams. The total volume of take and use licences in the Avoca basin includes licences for irrigation as well as for domestic and stock purposes. Entitlements include rights granted to individuals (take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations or environmental entitlements granted to the VEWH). Rights to water in the Avoca basin are outlined in Table 6-188.

Table 6-188 Entitlement volumes in the Avoca basin

Water entitlements	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 volume of water entitlements in the Avoca basin	**2,967**

Allocation available under bulk entitlements and licences for 2016–17 is presented in Table 6-189. There were no diversions under take and use licences for irrigation in 2016–17 (Table 6-189); 40 ML was taken under take and use licences for domestic and stock purposes. Avoca and Redbank were mostly supplied from groundwater in 2016–17.

Table 6-189 Allocation account balance summary for the Avoca basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Amphitheatre	25	0	12	13
Avoca	233	0	19	214
Redbank	20	0	0	20
Take and use licences - unregulated surface water	2,689	0	40	2,689
Total 2016–17	**2,967**	**0**	**71**	**2,936**
Total 2015–16	2,967	0	63	2,904

The estimated volume of water harvested from small catchment dams represents the largest diversion of water in the Avoca basin (Table 6-190). The capacity of small catchment dams for Avoca basin is estimated based on GIS mapping. The GIS data used to derive the capacity values for small catchment dams was updated in 2015–16, to provide a more-accurate measure.

Table 6-190 Estimated small catchment dam information for the Avoca basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	10,285	5,143	n/a
Registered commercial and irrigation	5,503	4,623	n/a
Total	**15,788**	**9,765**	**18,314**

n/a Information not available.

6.30.3 Recycled water

Grampians Wimmera Mallee Water and Central Highlands Water operate wastewater treatment plants within the Avoca basin. In 2016–17, 27% of wastewater was recycled, unlike the previous year where 100% was recycled. The recycled water was used for urban, industrial and agricultural purposes. Table 6-191 shows the volumes and uses of recycled water in the Avoca basin in 2016–17. Where water has been recycled within the plant process, this volume has not been included in the percent recycled value.

Table 6-191 Volume and use of recycled water in the Avoca basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled (excludes within plant process)	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	29	29	100%	0	29	0	0	0	0
Charlton	61	0	0%	0	0	0	0	0	61
Sea Lake	33	0	0%	0	0	0	0	0	33
St Arnaud	174	50	29%	35	15	0	0	94	30
Total 2016–17	**297**	**79**	**27%**	**35**	**44**	**0**	**0**	**94**	**124**
Total 2015–16	133	133	100%	47	85	0	0	0	0

7. Groundwater catchment accounts

7.1 Overview

7.1.1 Introduction

This chapter outlines the approach used for presenting the information in the groundwater catchment accounts. 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:

- responses to requests for data from water corporations, Department of Environment, Land, Water and Planning 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:

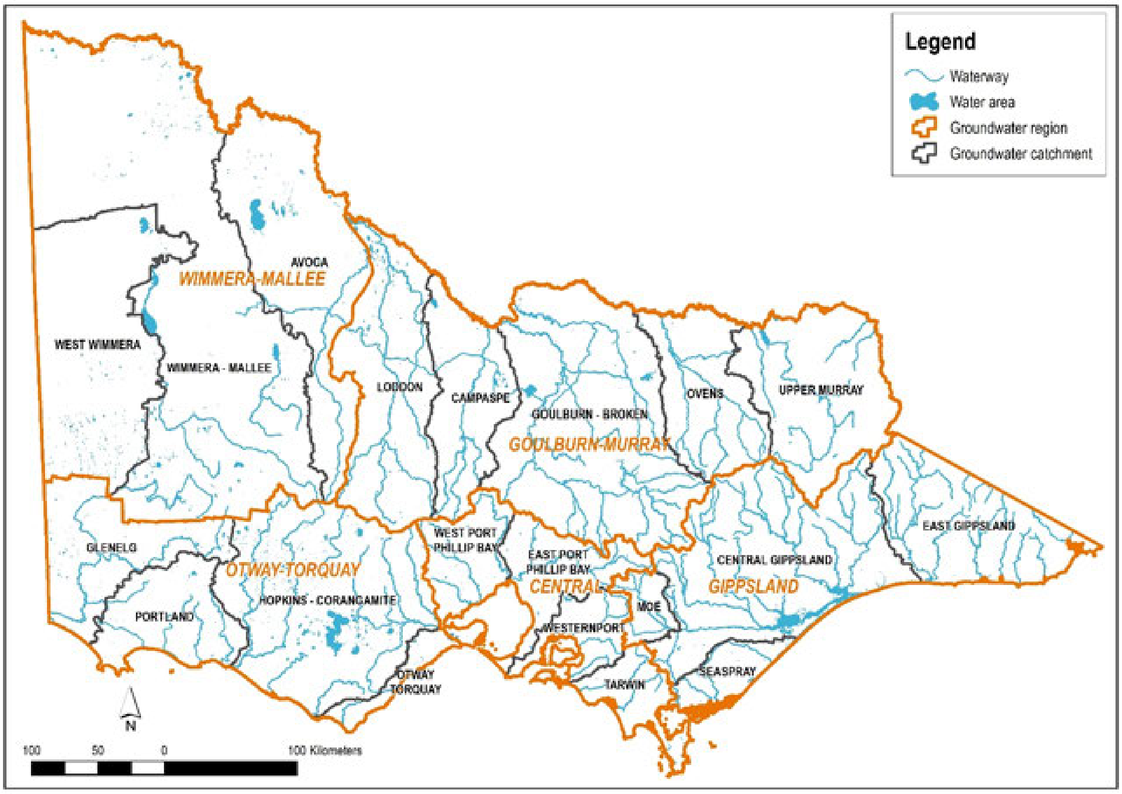
- groundwater regions
- groundwater catchments
- groundwater management units (GMUs).

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 by Goulburn Murray Water and Grampians Wimmera Mallee Water respectively.

For administrative purposes, each groundwater region has several groundwater catchments, shown in Figure 7-1**.** A groundwater catchment approximates the surface water catchment with adjustments based on 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 Water Supply Protection Areas (WSPAs) and Groundwater Management Areas (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 South West Limestone GMA and the 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 'permissible consumptive volume' (PCV). PCVs are declared by the Minister for Water through an order published in the government gazette. Adaptive management occurs through take and use licenses, single-source urban water bulk entitlements, statutory groundwater management plans (GMPs), local management plans (LMPs), 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.

7.1.2.1 Licensed groundwater volumes and use

This table 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 domestic and stock use where such use is included in a groundwater licence.

7.1.2.2 Number of domestic and stock bores and estimated use

This table 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*, 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 (see chapter 7.1.2.1).

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 is 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 where GMUs overlap. To better account for domestic and stock bores outside management units, bores that are located spatially within a GMU, but which do not have a constructed depth within the GMU's depth range, are allocated to these areas.

7.1.2.3 Urban groundwater volumes and metered use

This table 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 groundwater volumes and use stated in chapter 7.1.2.1 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 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 region also forms part of the Murray River basin in Victoria.

The hydrogeology of the region can be broadly subdivided into two distinct geological regions: 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 basement rock, which is comprised of sedimentary fractured rock. Basement rock 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.

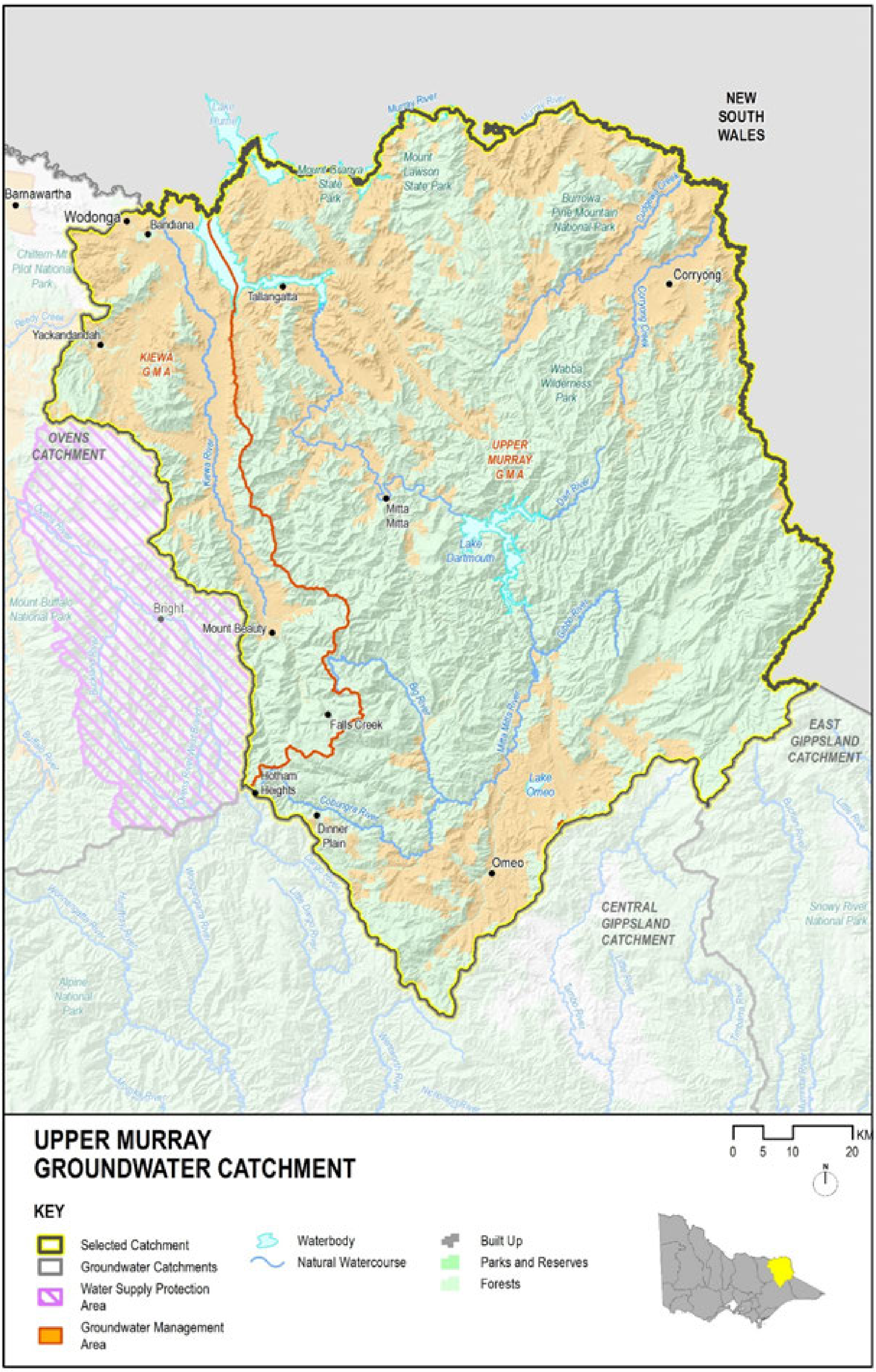
In the north, the plain of the Goulburn–Murray region gradually thickens into several geological layers.

- The Upper Tertiary Quaternary Aquifer (UTQA) 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 UTQA 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 basement rock, 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) and lies within part of the Murray River basin. 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. 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 2016–17 are presented in Table 7-1. The groundwater trend was categorised as stable for the whole of 2016–17. Observation bores were identified for the Kiewa and Upper Murray GMAs during 2016–17: they were categorised as stable for the last six months of the year.

Table 7-1 Groundwater management unit trends

Groundwater management unit	Groundwater level trend 2016–17				Groundwater level trend June 2016
	Sep-16	Dec-16	Mar-17	Jun-17	
Water supply protection area					
Upper Ovens	Stable	Stable	Stable	**Stable**	Stable
Groundwater management area					
Kiewa	-	-	Stable	**Stable**	-
Upper Murray	-	-	Stable	**Stable**	-

7.2.1.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs are presented in Table 7-2. Groundwater use increased in 2016–17, compared to 2015–16.

Table 7-2 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2016–17	Total licensed groundwater use (ML) 2015–16
Kiewa GMA	All depths	3,122	405	391
Upper Murray GMA	All depths	3,403	440	511
Outside management units	-	0	0	0
Total		**6,525**	**845**	**902**

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

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 2 ML per bore)
Kiewa GMA	275	550
Upper Murray GMA	187	374
Outside management units	11	22
Total	**473**	**946**

Groundwater is used to provide urban water supply to Dinner Plain. The licensed entitlements and metered use for these supplies are presented in Table 7-4.

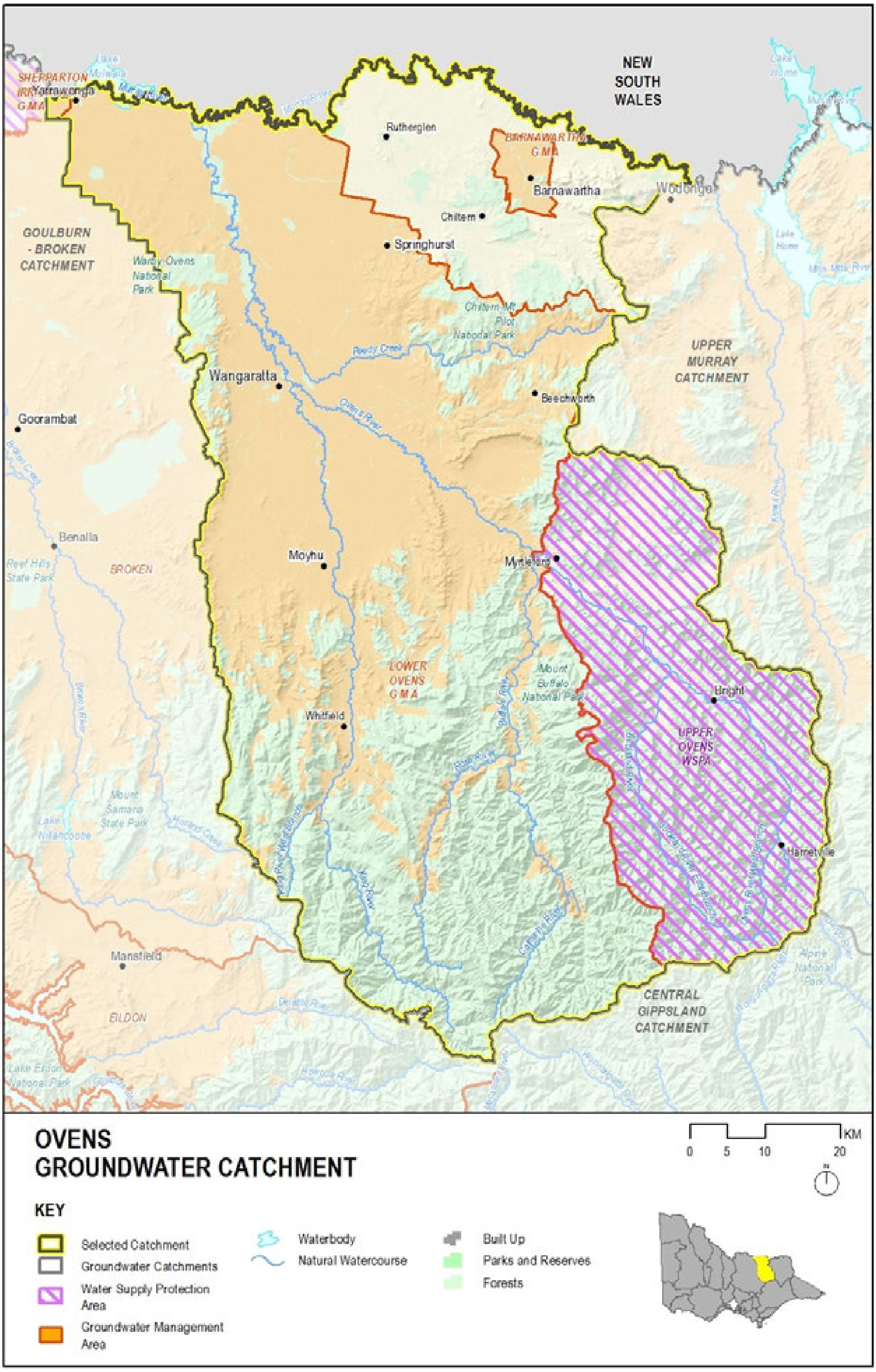
Table 7-4 Urban groundwater use

Town supplied	Licensed volume (ML)	Metered use 2016–17 (ML)	Metered use 2015–16 (ML)
Dinner Plain	120	41	47
Total	**120**	**41**	**47**

7.2.2 Ovens groundwater catchment

The Ovens groundwater catchment is located in northern Victoria (Figure 7-3). It extends from the Murray River in the north to the Great Dividing Range in the south, and contains the Kiewa and Ovens river basins.

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 and bore construction. 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 six other towns in the area.

The groundwater level trends for 2016–17 are presented in Table 7-5. Towards the end of 2016–17, the Lower Ovens GMA groundwater level trend was classified as declining, whereas the Upper Ovens WSPA trend was categorised as stable for the whole year. During 2016–17, observation bores were identified to determine a trend for Barnawartha GMA, which began and ended the year stable and had rising levels during the year.

Table 7-5 Groundwater management unit trends

Groundwater management unit	Groundwater level trend 2016–17				Groundwater level trend June 2016
	Sep-16	Dec-16	Mar-17	Jun-17	
Water supply protection area					
Upper Ovens	Stable	Stable	Stable	**Stable**	Stable
Groundwater management area					
Barnawartha	Stable	Rising	Rising	**Stable**	-
Lower Ovens	Declining	Stable	Stable	**Declining**	Declining

Note
(1) The Upper Ovens WSPA is partly contained within the Upper Murray groundwater catchment.

7.2.2.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs are presented in Table 7-6. Groundwater use increased in 2016–17, compared to 2015–16.

Table 7-6 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits(m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2016–17	Total licensed groundwater use (ML) 2015–16
Barnawartha GMA	All depths	375	6	9
Lower Ovens GMA	All depths	19,905	5,839	5,494
Upper Ovens WSPA	All depths	3,650	970	973
Outside management units	-	2,294	720	905
Total		**26,224**	**7,535**	**7,381**

An estimate of domestic and stock groundwater use is shown in Table 7-7. 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 7-6.

Table 7-7 Number of domestic and stock bores and estimated use

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 2 ML per bore)
Barnawartha GMA	25	50
Lower Ovens GMA	1,507	3,014
Upper Ovens WSPA	256	512
Outside management units	126	252
Total	**1,914**	**3,828**

Note
(1) Although a very small portion of the Shepparton Irrigation GMA is located in the north-west of the Ovens catchment, no domestic and stock bores were reported to have been in this area in 2016–17.

Groundwater in the Ovens groundwater catchment is an available urban water option supply for Barnawartha and as a backup urban water supply for Bright, Chiltern, Moyhu, Springhurst and Wangaratta. The volume of licensed entitlements and metered use for these groundwater supplies are shown in Table 7-8.

In 2016–17, no groundwater was supplied to Barnawartha, Chiltern, Moyhu or Springhurst. Urban groundwater supply to Bright and Wangaratta in 2016–17 increased from the previous year.

Table 7-8 Urban groundwater volumes and metered use

Town supplied	Licensed volume (ML)	Metered use 2016–17 (ML)	Metered use 2015–16 (ML)
Barnawartha	293	0	0
Bright	75	38	9
Chiltern	25	0	0
Moyhu	15	0	15
Springhurst	20	0	0
Wangaratta	665	72	69
Total	**1,093**	**110**	**93**

7.2.3 Goulburn–Broken groundwater catchment

The Goulburn–Broken groundwater catchment is located in northern Victoria (Figure 7-4) and contains the Goulburn and Broken river basins. 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 and bore construction, as well as for surface water diversions. 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 contains the Mid Goulburn GMA, most of the Shepparton Irrigation GMA (which also extends into the Campaspe groundwater catchment), the Strathbogie GMA, the Upper Goulburn GMA, the Broken GMA, the Eildon GMA and the Katunga WSPA. The Broken and Eildon GMA management plans were approved in October and September 2016 respectively.

Groundwater resources supply irrigation, domestic and stock use, and urban use in Goorambat, Katunga and Strathmerton.

The groundwater level trends for 2016–17 are presented in Table 7-9. The trends varied from declining to rising across the GMUs within the Goulburn-Broken catchment. Observation bores were identified for the Broken, Strathbogie and Upper Goulburn GMAs during 2016–17: they were categorised as stable at the end of the year. Insufficient observation bores were available to determine a trend for Eildon GMA.

Table 7-9 Groundwater management unit trends

Groundwater management unit	Groundwater level trend 2016–17				Groundwater level trend June 2016
	Sep-16	Dec-16	Mar-17	Jun-17	
Water supply protection area					
Katunga	Rising	Stable	Declining	**Declining**	Declining
Groundwater management area					
Broken	-	-	Stable	**Stable**	-
Mid Goulburn	Declining	Stable	Stable	**Declining**	Declining
Shepparton Irrigation	Stable	Stable	Rising	**Rising**	Stable
Strathbogie	Stable	Stable	Stable	**Stable**	-
Upper Goulburn	Declining	Stable	Declining	**Stable**	-

7.2.3.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs are presented in Table 7-10. Extractions from the Katunga WSPA were limited to 70% of licensed entitlement volume in 2016–17.

Like the previous year, groundwater use was lower in 2016–17 than in 2015–16.

Table 7-10 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2016–17	Total licensed groundwater use (ML) 2015–16
Broken GMA [1]	see note 1	2,887	388	
Eildon GMA	<=200 m	587	180	
Mid Goulburn GMA	Zone 1070: >25 Zone 1071: All depths	12,470	1,786	4,214
Shepparton Irrigation GMA	<=25 m	174,698	53,569	77,858
Strathbogie GMA	<=250 m	1,422	468	556
Upper Goulburn GMA	<=250 m	6,026	1,034	1,087
Katunga WSPA	>25 m	60,219	22,528	34,566
Outside management units	-	2,931	1,107	2,796
Total		**261,240**	**81,060**	**121,077**

Note

(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.

An estimate of domestic and stock groundwater use is shown in Table 7-11. 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 7-10.

Table 7-11 Number of domestic and stock bores and estimated use

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 2 ML per bore)
Broken GMA (1)	414	828
Eildon GMA (1)	281	562
Mid Goulburn GMA	124	248
Shepparton Irrigation GMA	1,182	2,364
Strathbogie GMA	277	554
Upper Goulburn GMA	542	1,084
Katunga WSPA	751	1,502
Outside management units	225	450
Total	**3,796**	**7,592**

Note

(1) The management plans for the Broken and Eildon GMAs were approved in October and September 2016 respectively.

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 except Katunga in 2016–17, compared to 2015–16.

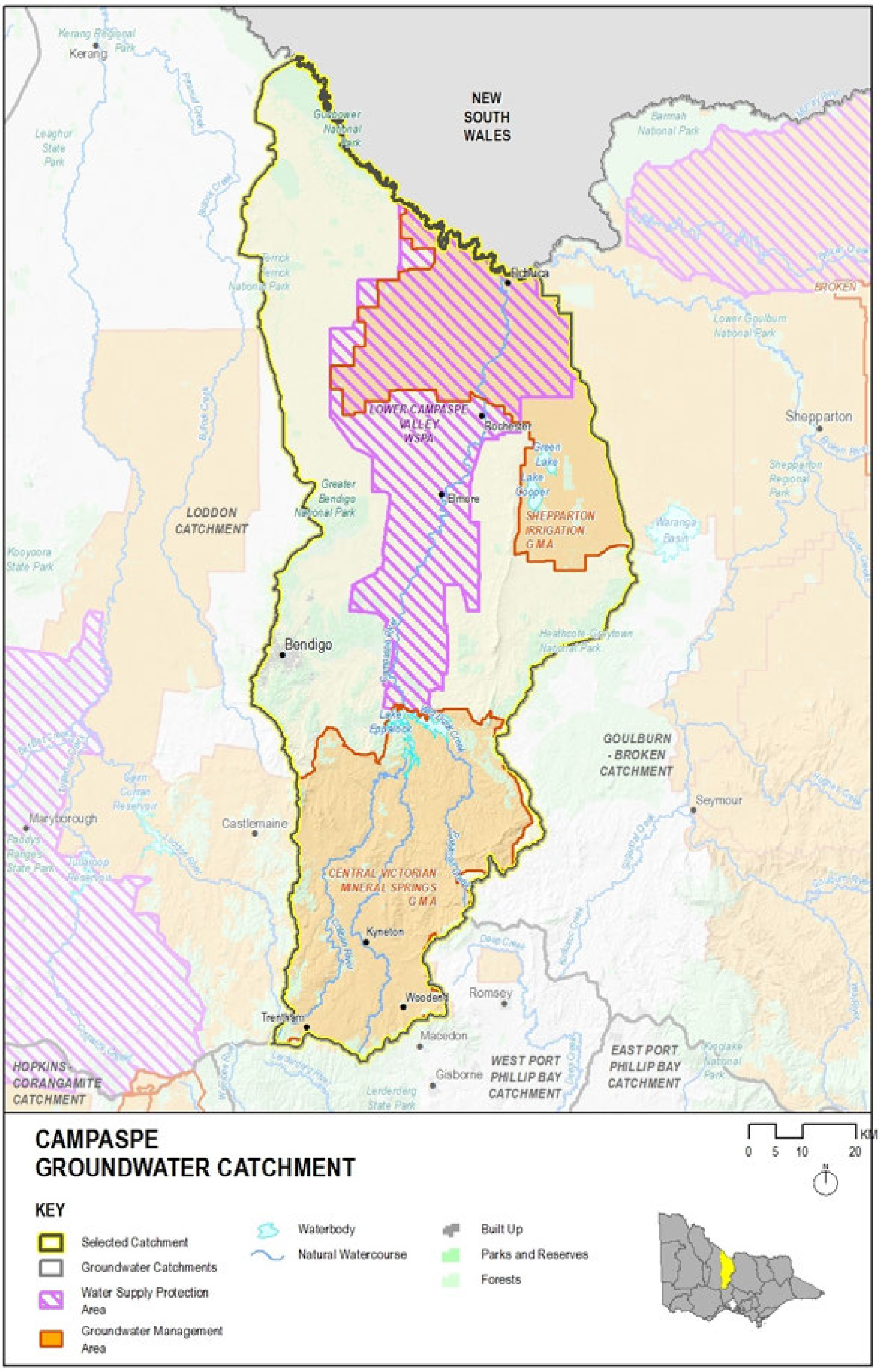
Table 7-12 Urban groundwater volumes and metered use

Town supplied	Licensed volume (ML)	Metered use 2016–17 (ML)	Metered use 2015–16 (ML)
Goorambat	24	10	13
Katunga	110	67	55
Strathmerton	730	0	55
Total	**864**	**77**	**123**

7.2.4 Campaspe groundwater catchment

The Campaspe groundwater catchment is located in northern Victoria (Figure 7-5) and corresponds with the Campaspe river basin. The catchment extends from the Murray River near Echuca in the north to the Great Dividing Range at Woodend and Trentham in the south.

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 and bore construction, as well as for surface water diversions. 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.

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 Campaspe groundwater catchment contains the Lower Campaspe Valley WSPA, part of the Shepparton Irrigation GMA (which extends 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.

The groundwater level trends for 2016–17 are presented in Table 7-13. The trends varied from declining to rising across the GMUs within the Campaspe catchment. Observation bores were identified for the Central Victorian Mineral Springs GMA during 2016–17: they were categorised as stable throughout the year.

Table 7-13 Groundwater management unit trends

Groundwater management unit	Groundwater level trend 2016–17				Groundwater level trend June 2016
	Sep-16	Dec-16	Mar-17	Jun-17	
Water supply protection area					
Lower Campaspe Valley	Declining	Declining	Declining	**Declining**	Declining
Groundwater management area					
Central Victorian Mineral Springs (1)	Stable	Stable	Stable	**Stable**	-
Shepparton Irrigation	Stable	Stable	Rising	**Rising**	Stable

Note
(1) The Central Victorian Mineral Springs GMA is partly contained within the Campaspe and Loddon groundwater catchments.

7.2.4.2 Groundwater entitlements and use

Licensed entitlements and use from GMUs within the Campaspe catchment are presented in Table 7-14. Unlike the previous year, groundwater use in 2016–17 was almost 50% lower than 2015–16.

Table 7-14 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits(m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2016–17	Total licensed groundwater use (ML) 2015–16
Central Victorian Mineral Springs GMA	see note 1	2,275	459	535
Lower Campaspe Valley WSPA	All depths	55,860	24,383	44,994
Shepparton Irrigation GMA	<=25	16,432	651	1,590
Outside management units	-	4,994	78	880
Total		**79,561**	**25,571**	**47,999**

Note
(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.

An estimate of domestic and stock groundwater use is shown in Table 7-15. 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 7-14.

Table 7-15 Number of domestic and stock bores and estimated use

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 2 ML per bore)
Central Victorian Mineral Springs GMA	898	1,796
Lower Campaspe Valley WSPA	534	1,068
Shepparton Irrigation GMA	123	246
Outside management units	281	562
Total	**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 decreased in 2016–17, compared to 2015–16. The licensed entitlements and metered use for this supply are shown in Table 7-16.

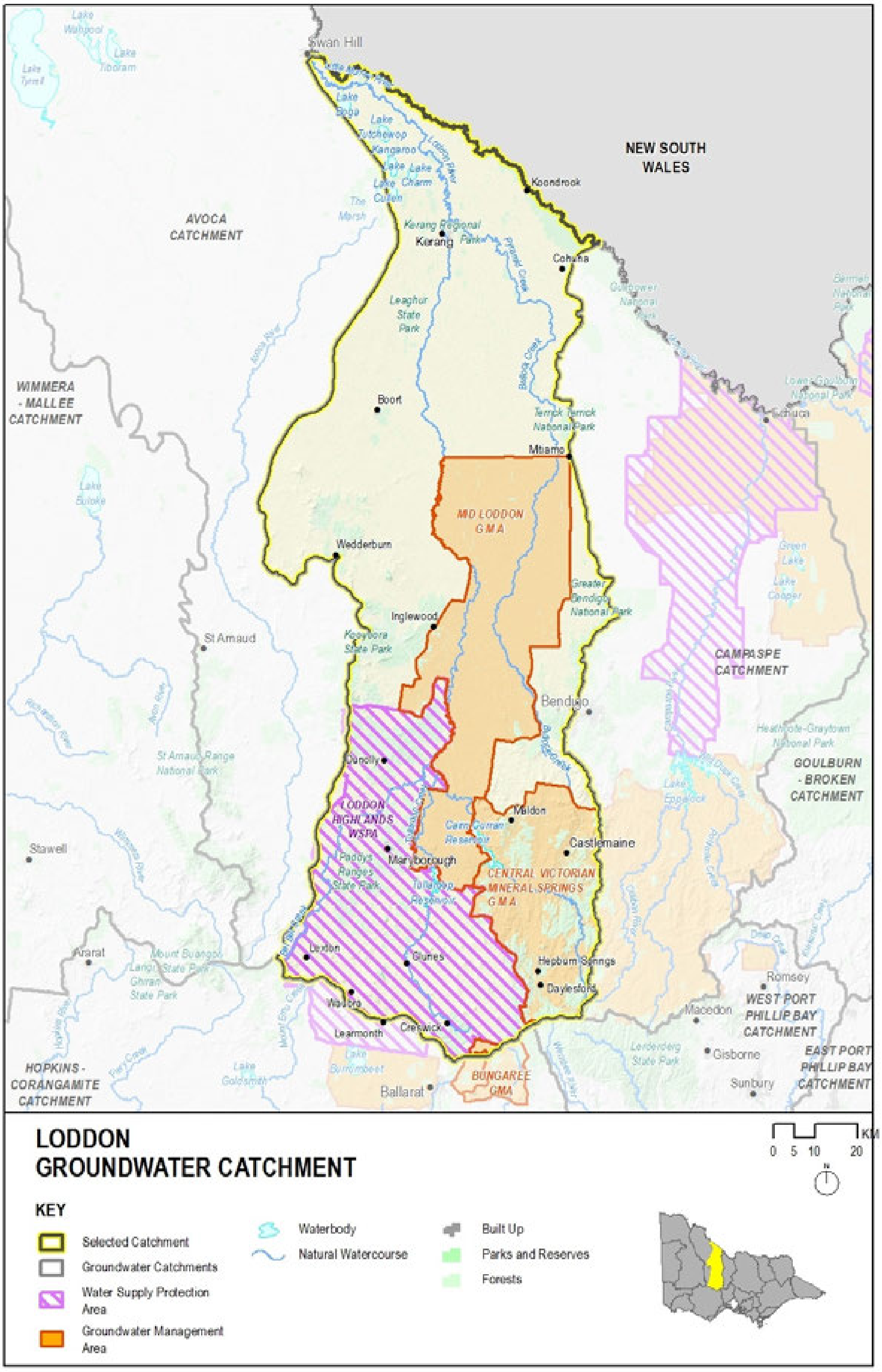
Table 7-16 Urban groundwater use

Town supplied	Licensed volume (ML)	Metered use 2016–17 (ML)	Metered use 2015–16 (ML)
Elmore	284	96	148
Trentham	48	21	42
Total	**332**	**117**	**190**

7.2.5 Loddon groundwater catchment

The Loddon groundwater catchment is located in northern Victoria (Figure 7-6) and broadly corresponds with the Loddon river basin. 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 and bore construction, as well as for surface water licensed diversions. 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 contains all of 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 2016–17 are presented in Table 7-17. The groundwater level trend was mostly categorised as declining throughout the Loddon groundwater catchment. Observation bores were identified for the Central Victorian Mineral Springs GMA during 2016–17: they were categorised as stable throughout the year.

Table 7-17 Groundwater management unit trends

Groundwater management unit	Groundwater level trend 2016–17				Groundwater level trend June 2016
	Sep-16	Dec-16	Mar-17	Jun-17	
Water supply protection area					
Loddon Highlands	Declining	Declining	Declining	**Declining**	Declining
Groundwater management area					
Mid Loddon	Declining	Stable	Declining	**Declining**	Declining
Central Victorian Mineral Springs (1)	Stable	Stable	Stable	**Stable**	-

Note
(1) The Central Victorian Mineral Springs GMA is partly contained within the Campaspe and Loddon groundwater catchments.

7.2.5.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs are presented in Table 7-18. In the Loddon groundwater catchment, the allocation limits varied across the Loddon Highlands WSPA zones for entitlement holders:

- the Newlyn zone began the year with a 50% seasonal allocation, which was raised to 75% in October 2016
- the 75% allocation limit on the Ascot and Blampied zones was lifted in November 2016, with entitlement holders able to access 100% of the allocation limit through to the end of the water year
- all other zones had a 100% allocation limit.

Similar to the previous year where use had dropped by about 45% from the year before, in 2016–17 groundwater use in the catchment was about 50% lower than the previous year.

Table 7-18 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits(m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2016–17	Total licensed groundwater use (ML) 2015–16
Central Victorian Mineral Springs GMA	See note 1	2,739	423	534
Mid Loddon GMA	All depths	33,927	12,285	25,249
Loddon Highlands WSPA	All depths	20,507	5,435	10,149
Outside management units	-	8,695	674	64
Total		**65,868**	**18,817**	**35,996**

Note
(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.

An estimate of domestic and stock groundwater use is shown in Table 7-19. A number of 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

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 2 ML per bore)
Central Victorian Mineral Springs GMA	502	1,004
Loddon Highlands WSPA	502	1,004
Mid Loddon GMA	331	662
Outside management units	111	222
Total	**1,446**	**2,892**

Note
(1) Estimated domestic and stock use for Bungaree GMA is calculated using a factor of 1.5 ML per bore.

Groundwater is an urban water supply option for six towns within the catchment. In 2016–17, metered use was similar to the previous year except for Maryborough, which increased significantly. 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

Town supplied	Licensed volume (ML)	Metered use 2016–17 (ML)	Metered use 2015–16 (ML)
Clunes	353	218	228
Daylesford	273	89	67
Forest Hill	350	132	160
Learmonth	100	48	58
Maryborough (1)	565	126	32
Waubra	70	28	31
Total	**1,711**	**641**	**576**

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 basement rock. Where the lower aquifers occur at or near the surface, they receive direct recharge from rainfall and river leakage: in the deeper 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 and encompasses the rivers of the East Gippsland and Snowy basins. 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 is also responsible for issuing bore construction licenses and licensing groundwater extractions under take and use licences.

The East Gippsland groundwater catchment contains the Orbost GMA. Groundwater supplies irrigation, domestic and stock use and Mallacoota.

The groundwater level trends for 2016–17 are presented in Table 7-21. The groundwater level trend was categorised as stable throughout most of 2016–17, but was categorised as declining in June 2017.

Table 7-21 Groundwater management unit trends

Groundwater management unit	Groundwater level trend 2016–17				Groundwater level trend June 2016
	Sep-16	Dec-16	Mar-17	Jun-17	
Groundwater management area					
Orbost	Stable	Stable	Stable	**Declining**	Declining

7.3.1.2 Groundwater entitlements and use

Licensed groundwater entitlements and use for the Orbost GMA and UAs are shown in Table 7-22. Groundwater use decreased in 2016–17, compared to 2015–16.

Table 7-22 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits(m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2016–17	Total licensed groundwater use (ML) 2015–16
Orbost GMA	20–45	1,217	104	154
Outside management units	-	537	89	95
Total		**1,754**	**193**	**249**

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

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	**66**	**100**

Within the East Gippsland catchment, groundwater is available for urban water supply to Mallacoota. Urban groundwater use in the East Gippsland catchment decreased slightly in 2016–17, compared to 2015–16. The licensed entitlements and metered use for this supply are shown in Table 7-24.

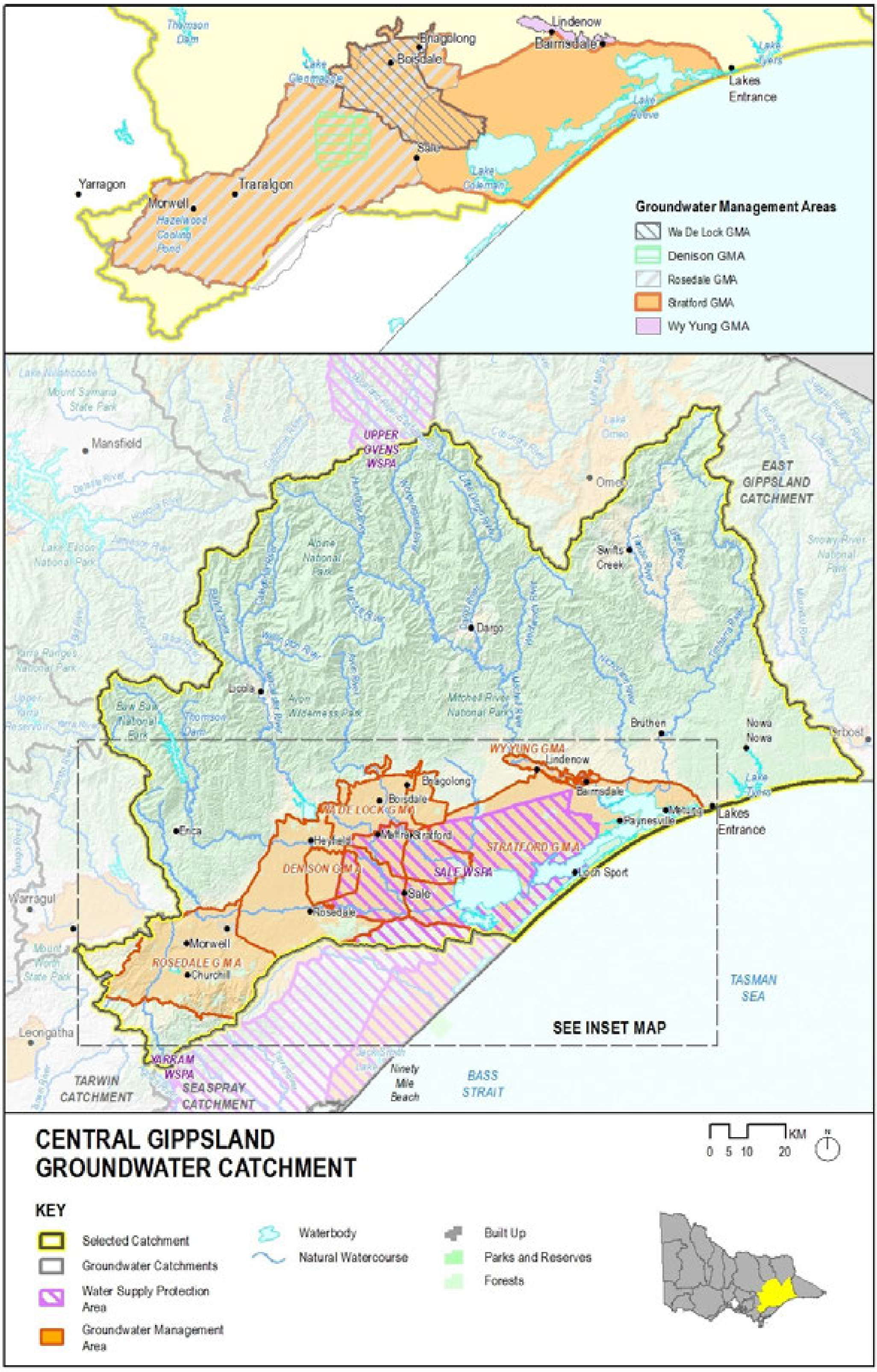
Table 7-24 Urban groundwater volumes and metered use

Town supplied	Licensed volume (ML)	Metered use 2016–17 (ML)	Metered use 2015–16 (ML)
Mallacoota	220	80	92
Total	**220**	**80**	**92**

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. It encompasses the major systems of the Gippsland Lakes and contains the Tambo, Mitchell and Thomson basins and parts of the Latrobe and Snowy basins. Neighbouring groundwater catchments are the Goulburn–Broken and Moe to the north-west and west, the Ovens and Upper Murray to the north, the 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 is also responsible for issuing bore construction licences and for the licensing of groundwater extractions under take and use licences.

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 2016–17 are presented in Table 7-25. The groundwater level trends varied between declining and stable, with most declining in June 2017.

Table 7-25 Groundwater management unit trends

Groundwater management unit	Groundwater level trend 2016–17				Groundwater level trend June 2016
	Sep-16	Dec-16	Mar-17	Jun-17	
Water supply protection area					
Sale	Declining	Declining	Stable	**Stable**	Stable
Yarram (1)	Declining	Declining	Declining	**Declining**	Declining
Groundwater management area					
Rosedale (2)	Declining	Declining	Declining	**Declining**	Rising
Stratford (2)	Declining	Declining	Declining	**Declining**	Stable
Wa De Lock	Stable	Stable	Stable	**Stable**	Stable
Wy Yung	Stable	Stable	Stable	**Stable**	Stable
Moe	Declining	Declining	Declining	**Declining**	Declining

Notes
(1) Yarram WSPA water levels are influenced by off-shore oil and gas extraction.
(2) Rosedale and Stratford GMAs include the dewatering activities from the Loy Yang and Morwell coal mines.

7.3.2.2 Groundwater entitlements and use

Licensed entitlements and use from GMAs in the Central Gippsland catchment are shown in Table 7-26. Groundwater use in the Central Gippsland groundwater catchment slightly decreased in 2016–17, compared to 2015–16.

Table 7-26 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits(m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2016–17	Total licensed groundwater use (ML) 2015–16
Denison GMA (2)	<=25	18,499	6,882	8,741
Moe GMA	>25	33	11	11
Rosedale GMA (1)	Zone 1: 50–150 Zone 2: 25-350 Zone 3: 200–300	22,322	7,573	11,401
Sale WSPA	25-200	21,218	11,982	10,172
Stratford GMA (1)	Zone 1: >150 Zone 2: >350	36,681	25,089	21,803
Wa De Lock GMA (2)	<=25	29,140	6,984	7,201
Wy Yung GMA	<=25	7,462	560	414
Yarram WSPA	Zone 1: >200 Zone 2: All depths	6,889	4,511	3,901
Outside management units	-	20,126	2,344	2,312
Total		**162,370**	**65,936**	**65,956**

Notes
(1) The use volume reported in Rosedale GMA and Stratford GMA includes reported extractions from Latrobe Valley mines (Rosedale GMA 860 ML and Stratford GMA 25,807 ML).
(2) The volume of use in Wa De Lock GMA and Denison WSPA includes metered extractions for salinity control (Wa De Lock GMA 749 ML and Denison WSPA 691 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

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 1.5 ML per bore) (ML)
Rosedale GMA	86	129
Moe GMA	0	0
Stratford GMA (1)	4	8
Wa De Lock GMA	416	624
Denison GMA	201	302
Sale WSPA	422	633
Wy Yung GMA	33	50
Yarram WSPA	87	131
Outside management units	615	923
Total	**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

Town supplied	Licensed volume (ML)	Metered use 2016–17 (ML)	Metered use 2015–16 (ML)
Boisdale	37	37	0
Briagolong	160	79	63
Lindenow	171	0	0
Sale	3,480	1,846	1,850
Total	**3,848**	**1,962**	**1,913**

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, and falls within the South Gippsland river basin. 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 is also responsible for issuing bore construction licences and for the licensing of groundwater extractions under take and use licences.

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 2016–17 are presented in Table 7-29. The groundwater level trends were mostly categorised as declining except for the Giffard GMA, which was classified as stable.

Table 7-29 Groundwater management unit trends

Groundwater management unit	Groundwater level trend 2016–17				Groundwater level trend June 2016
	Sep-16	Dec-16	Mar-17	Jun-17	
Water supply protection area					
Yarram [1]	Declining	Declining	Declining	**Declining**	Declining
Groundwater management area					
Giffard	Stable	Stable	Stable	**Stable**	Declining
Stratford [2]	Declining	Declining	Declining	**Declining**	Stable

Notes

(1) Yarram WSPA water levels are influenced by off-shore oil and gas extraction.
(2) Stratford include the dewatering activities from the Loy Yang and Morwell coal mines.

7.3.3.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs in the Seaspray catchment are shown in Table 7-30. Groundwater use decreased by about 29% in 2016–17, compared to 2015–16.

Table 7-30 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits(m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2016–17	Total licensed groundwater use (ML) 2015–16
Giffard GMA	50–200	5,689	1,856	2,312
Stratford GMA	Zone 1: >150 Zone 2: >350	272	14	21
Yarram WSPA	Zone 1: >200 Zone 2: All depths	18,800	7,735	11,040
Outside management units	-	518	131	272
Total		**25,279**	**9,736**	**13,645**

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

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 1.5 ML per bore) (ML)
Giffard GMA	93	140
Stratford GMA	0	0
Yarram WSPA	184	276
Outside management units	71	107
Total	**348**	**523**

Groundwater supplies are available for Yarram. The licensed entitlements and metered use for urban supply are presented in Table 7-32.

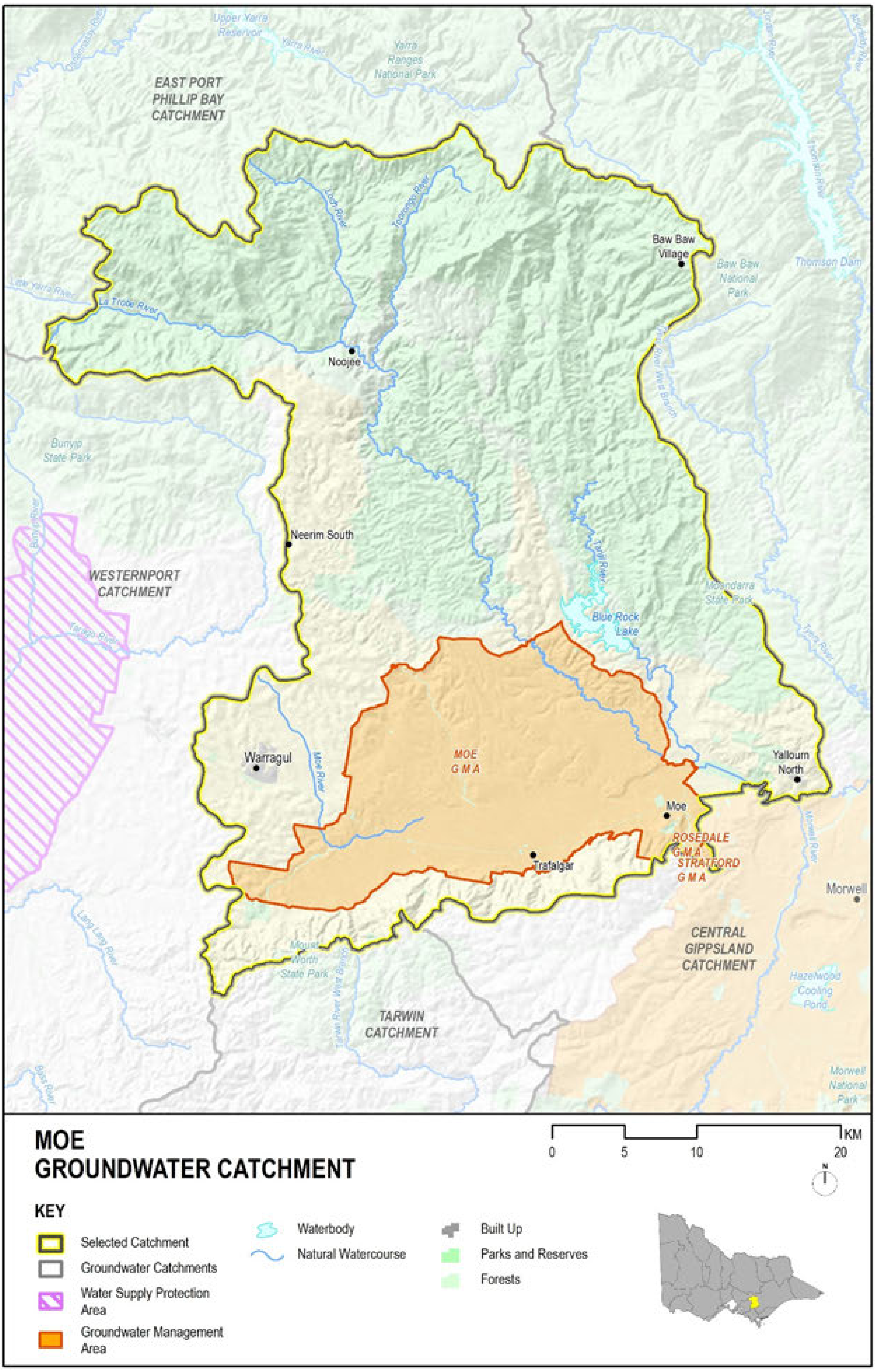
Table 7-32 Urban groundwater volumes and metered use

Town supplied	Licensed volume (ML)	Metered use 2016–17 (ML)	Metered use 2015–16 (ML)
Yarram	214	0	115
Total	**214**	**0**	**115**

7.3.4 Moe groundwater catchment

The Moe groundwater catchment (Figure 7-10) is located in the Gippsland groundwater region in eastern Victoria and falls within the Latrobe river basin. 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 is also responsible for issuing bore construction licences and for the licensing groundwater extractions under take and use licences.

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 trends for 2016–17 are presented in Table 7-33. The groundwater level trend was categorised as declining throughout the year.

Table 7-33 Groundwater management unit trends

Groundwater management unit	Groundwater level trend 2016–17				Groundwater level trend June 2016
	Sep-16	Dec-16	Mar-17	Jun-17	
Groundwater management area					
Moe	Declining	Declining	Declining	**Declining**	Declining

7.3.4.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs are presented in Table 7-34. Groundwater use was about one-third lower in 2016–17, compared to 2015–16.

Table 7-34 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits(m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2016–17	Total licensed groundwater use (ML) 2015–16
Moe GMA	>25	3,856	903	1,211
Outside management units	-	1,361	130	360
Total		**5,217**	**1,033**	**1,571**

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

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 1.5 ML per bore) (ML)
Moe GMA	112	168
Outside management units	98	147
Total	**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

Town supplied	Licensed volume (ML)	Metered use 2016–17 (ML)	Metered use 2015–16 (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 flood plains 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 basement rock 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 basement rock 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 basement rock are at the surface; elsewhere recharge occurs as leakage.

7.4.1 Tarwin groundwater catchment

The Tarwin groundwater catchment is located in south-eastern Victoria (Figure 7-11) and overlaps part of the South Gippsland river basin. 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 is also responsible for issuing bore construction licences and for the licensing groundwater extractions under take and use licences.

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 2016–17 are shown in Table 7-37. The groundwater level trends have been mostly stable during the year.

Table 7-37 Groundwater management unit trends

Groundwater management unit	Groundwater level trend 2016–17				Groundwater level trend June 2016
	Sep-16	Dec-16	Mar-17	Jun-17	
Groundwater management area					
Leongatha	Stable	Stable	Stable	**Declining**	Declining
Tarwin	Stable	Stable	Declining	**Stable**	Stable

7.4.1.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs are shown in Table 7-38. There was slightly less groundwater use in 2016–17, compared to 2015–16.

Table 7-38 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits(m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2016–17	Total licensed groundwater use (ML) 2015–16
Leongatha GMA	All depths	1,803	115	206
Tarwin GMA	<=25	38	5	7
Outside management units	-	344	39	37
Total		**2,185**	**159**	**250**

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

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 1.5 ML per bore) (ML)
Leongatha GMA	72	108
Tarwin GMA	493	740
Outside management units	253	380
Total	**818**	**1,228**

Groundwater supply is available for Leongatha, but there was no metered use of groundwater for urban supply in 2016–17 (Table 7-40).

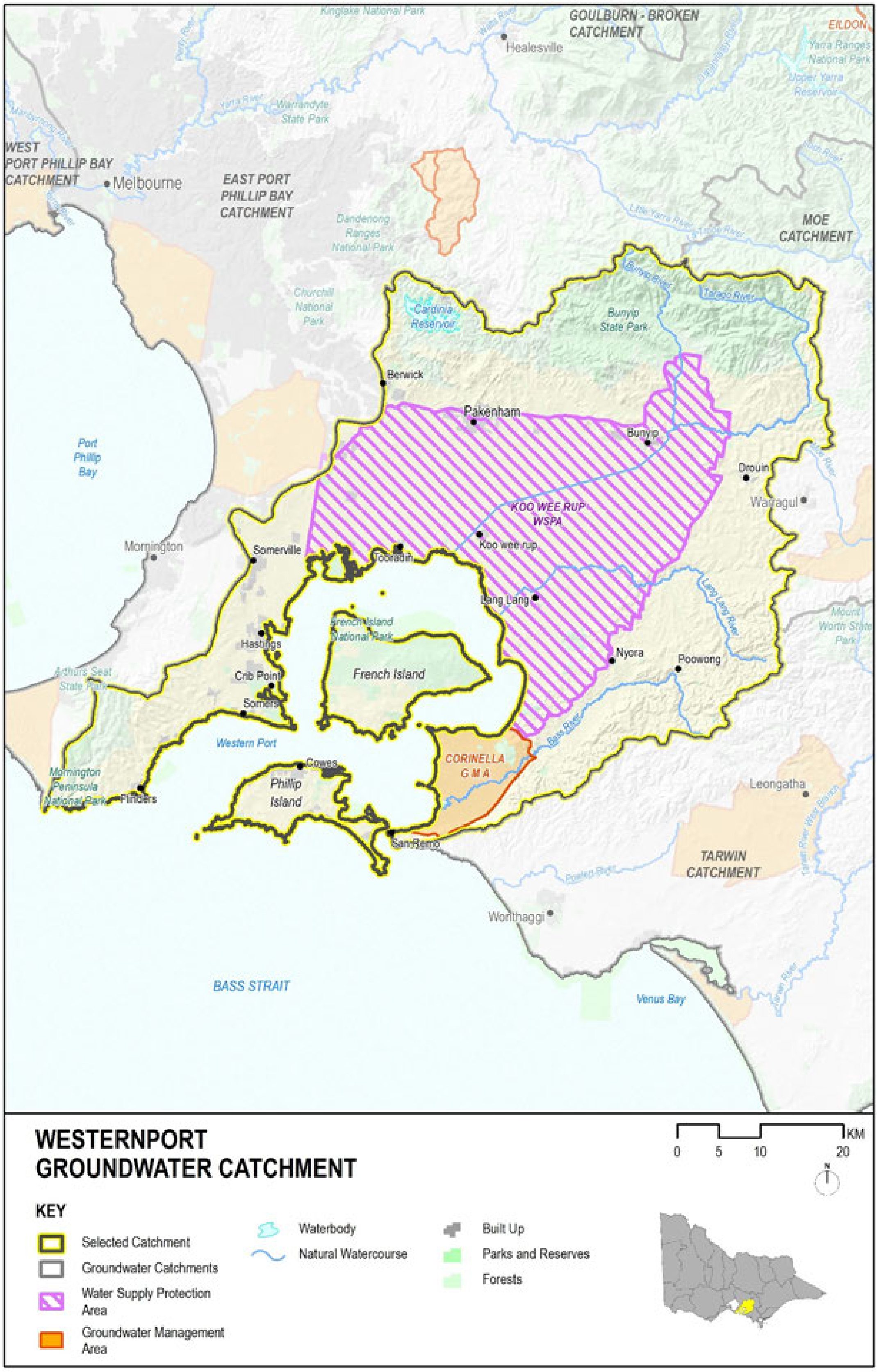
Table 7-40 Urban groundwater volumes and metered use

Town supplied	Licensed volume (ML)	Metered use 2016–17 (ML)	Metered use 2015–16 (ML)
Leongatha	715	0	0
Total	**715**	**0**	**0**

7.4.2 Westernport groundwater catchment

The Westernport groundwater catchment is located in southern Victoria (Figure 7-12) and contains much of the Bunyip river basin. 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 is also responsible for issuing bore construction licences and for the licensing of groundwater extractions under take and use licences.

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 license entitlements, domestic and stock use and the towns of Corinella, Grantville and Lang Lang.

The groundwater level trends for 2016–17 are shown in Table 7-41. The groundwater level trends were mostly categorised as stable throughout the groundwater catchment.

Table 7-41 Groundwater management unit trends

Groundwater management unit	Groundwater level trend 2016–17				Groundwater level trend June 2016
	Sep-16	Dec-16	Mar-17	Jun-17	
Water supply protection area					
Koo Wee Rup	Declining	Stable	Stable	**Stable**	Declining
Groundwater management area					
Corinella	Stable	Stable	Stable	**Stable**	Declining

7.4.2.2 Groundwater entitlements and use

Licensed entitlements and use from GMUs within the Westernport catchment are shown in Table 7-42. Total groundwater use decreased in 2016–17, compared to 2015–16.

Table 7-42 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits(m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2016–17	Total licensed groundwater use (ML) 2015–16
Corinella GMA	All depths	662	66	72
Koo Wee Rup WSPA	All depths	12,466	3,503	4,348
Outside management units	-	4,469	507	578
Total		**17,597**	**4,076**	**4,998**

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

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	954	1,431
Outside management units	432	648
Total	**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 2016–17 (Table 7-44).

Table 7-44 Urban groundwater volumes and metered use

Town supplied	Licensed volume (ML)	Metered use 2016–17 (ML)	Metered use 2015–16 (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) and overlaps parts of the Yarra and Bunyip river basins. 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 is also responsible for issuing bore construction licences and for the licensing of groundwater extractions under take and use licences.

The East Port Phillip Bay groundwater catchment contains the Frankston GMA, Moorabbin GMA, Nepean GMA and a small part of Koo Wee Rup WSPA (which is mainly within the Westernport groundwater catchment). Wandin Yallock GMA (which had its WSPA status revoked by the Minister for Water in December 2016) is also located in this groundwater catchment.

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 2016–17 are shown in Table 7-45. The groundwater level trends varied across the groundwater catchment during the year between stable and declining. Observation bores were identified for the Moorabbin GMA during 2016–17: they were categorised as declining for most of the year.

Table 7-45 Groundwater management unit trends

Groundwater management unit	Groundwater level trend 2016–17				Groundwater level trend June 2016
	Sep-16	Dec-16	Mar-17	Jun-17	
Water supply protection area					
Koo Wee Rup	Declining	Stable	Stable	**Stable**	Declining
Groundwater management area					
Frankston	Stable	Stable	Stable	**Stable**	Declining
Moorabbin	Declining	Stable	Declining	**Declining**	-
Nepean	Stable	Stable	Stable	**Stable**	Declining
Wandin Yallock	Declining	Declining	Declining	**Declining**	Declining

7.4.3.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs are shown in Table 7-46. Groundwater use across the East Port Phillip Bay groundwater catchment decreased by about 25% in 2016–17, compared to 2015–16.

Table 7-46 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits(m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2016–17	Total licensed groundwater use (ML) 2015–16
Frankston GMA	50–200	2,207	148	302
Moorabbin GMA	All depths	2,581	925	1,293
Nepean GMA	see note 1	6,110	2,304	2,961
Koo Wee Rup WSPA	All depths	111	0	0
Wandin Yallock GMA	All depths	2,994	564	743
Outside management units	-	12,758	1,807	2,450
Total		**26,761**	**5,748**	**7,749**

Note

(1) 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

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 1.5 ML per bore) (ML)
Frankston GMA	94	141
Moorabbin GMA	197	296
Nepean GMA	1,820	1,820
Koo Wee Rup WSPA	0	0
Wandin Yallock GMA	50	75
Outside management units	1,092	1,638
Total	**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 is also responsible for issuing bore construction licences and licensing groundwater extractions under take and use licences.

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.

The groundwater level trends for 2016–17 are shown in Table 7-48. Groundwater level trends were categorised between declining and stable, with most categorised as declining in June. Insufficient observation bores were available to determine a trend in the Cut Paw Paw GMA.

Table 7-48 Groundwater management unit trends

Groundwater management unit	Groundwater level trend 2016–17				Groundwater level trend June 2016
	Sep-16	Dec-16	Mar-17	Jun-17	
Water supply protection area					
Deutgam	Declining	Declining	Declining	**Declining**	Declining
Groundwater management area					
Lancefield	Stable	Stable	Stable	**Stable**	Declining
Merrimu	Stable	Stable	Stable	**Declining**	Declining

7.4.4.2 Groundwater entitlements and use

Licensed entitlements and use for GMUs are shown in Table 7-49. Groundwater use across the West Port Phillip Bay groundwater catchment decreased in 2016–17, compared to 2015–16. Deutgam WSPA received a seasonal allocation of 25% during 2016–17 on 1 July 16. On 24 November 2016, this increased to 50% when Southern Rural Water adopted new groundwater allocation rules to protect the Deutgam Aquifer and provide groundwater security.

Table 7-49 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits(m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2016–17	Total licensed groundwater use (ML) 2015–16
Cut Paw Paw GMA	>50	514	26	12
Lancefield GMA	All depths	1,378	193	80
Merrimu GMA	<=30	0	0	319
Deutgam WSPA	<=30	5,082	527	1,278
Outside management units	-	11,355	1,728	2,015
Total		**18,329**	**2,474**	**3,704**

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 2016–17, compared to 2015–16.

Table 7-50 Number of domestic and stock bores and estimated use

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
Lancefield GMA	52	78
Merrimu GMA	12	18
Deutgam WSPA	37	56
Outside management units	1,187	1,781
Total	**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 2016–17.

Table 7-51 Urban groundwater volumes and metered use

Town supplied	Licensed volume (ML)	Metered use 2016–17 (ML)	Metered use 2015–16 (ML)
Blackwood	50	1	6
Lancefield	294	13	0
Romsey	600	0	0
Total	**944**	**14**	**6**

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.

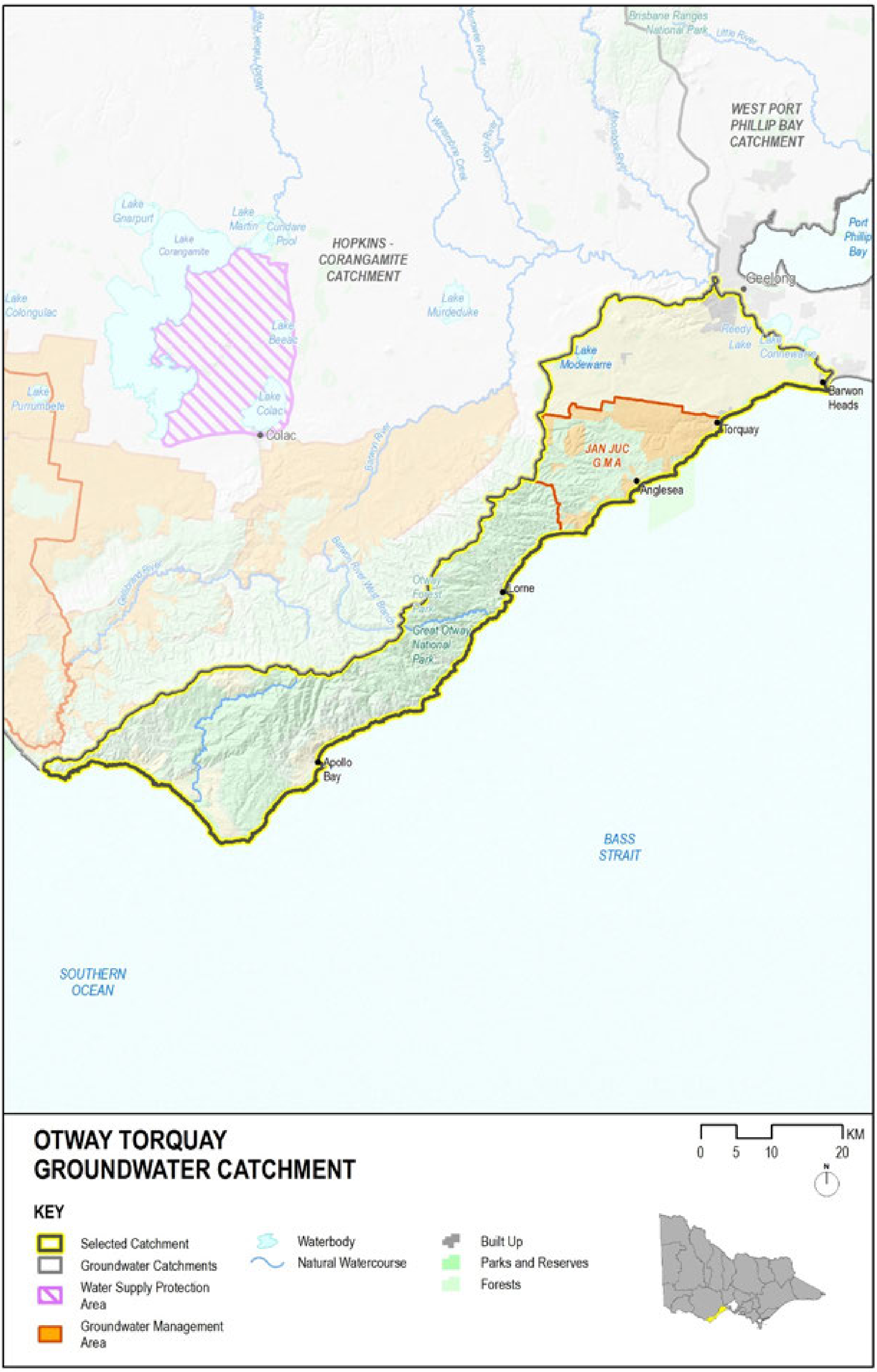
Most of the lower middle aquifer is confined by overlying layers and below by thick marl aquitards; the exception is the region along its northern reaches where it connects to the lower aquifers. The lower middle aquifer relies on upward and downward leakage from adjacent formations for recharge. Discharge 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 basement rock 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 and falls within the Otway Coast river basin. 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 is also responsible for issuing bore construction licences and for the licensing of groundwater extractions under take and use licences.

The Otway–Torquay catchment contains the Jan Juc GMA. Groundwater resources supply licence entitlements and domestic and stock use and Geelong.

The groundwater level trends for 2016–17 are shown in Table 7-52. The groundwater level trend for Jan Juc GMA was categorised as stable throughout most of 2016–17.

Table 7-52 Groundwater management unit trends

Groundwater management unit	Groundwater level trend 2016–17				Groundwater level trend June 2016
	Sep-16	Dec-16	Mar-17	Jun-17	
Groundwater management area					
Jan Juc	Declining	Stable	Stable	**Stable**	Declining

7.5.1.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs within the Otway–Torquay groundwater catchment are shown in Table 7-53. Total groundwater use for 2016–17 decreased significantly, compared to 2015–16. The majority of use was attributable to the Alcoa mine at Anglesea.

Table 7-53 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits(m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2016–17	Total licensed groundwater use (ML) 2015–16
Jan Juc GMA	All depths	14,250	223	1,341
Outside management units	All depths	95	1	0
Total		**14,345**	**224**	**1,341**

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

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	**30**	**46**

In the Otway–Torquay groundwater catchment, groundwater is used for urban water supply for greater Geelong. The licensed entitlements 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 including Anglesea, Torquay and Lorne. No groundwater was extracted under this bulk entitlement in 2016–17.

Barwon Water also hold 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

Town supplied	Licensed volume (ML)	Metered use 2016–17 (ML)	Metered use 2015–16 (ML)
Greater Geelong (Anglesea Bore Field) (1)	10,000	0	0
Total	**10,000**	**0**	**0**

Note

(1) Use over the last six 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 is also responsible for issuing licenses for groundwater use and bore construction.

The Hopkins–Corangamite groundwater catchment contains the Cardigan GMA, Colongulac GMA, Gellibrand GMA, Gerangamete GMA, Glenormiston GMA, Newlingrook GMA, Paaratte GMA and Warrion WSPA groundwater management units. 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 contained within the Hopkins–Corangamite groundwater catchment area. 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 2016–17 are shown in Table 7-56. The groundwater level trends were generally categorised as stable and observation bores were identified for Colongulac GMA and South West Limestone GMA during 2016–17.

Table 7-56 Groundwater management unit trends

Groundwater management unit (1)	Groundwater level trend 2016–17				Groundwater level trend June 2016
	Sep-16	Dec-16	Mar-17	Jun-17	
Water supply protection area					
Warrion	Declining	Stable	Stable	**Stable**	Declining
Groundwater management area					
Bungaree (2)	Stable	Stable	Stable	**Stable**	Declining
Cardigan	Declining	Stable	Stable	**Declining**	Declining
Colongulac	Stable	Stable	Rising	**Rising**	-
Gellibrand	Stable	Stable	Stable	**Stable**	Declining
Gerangamete	Declining	Stable	Stable	**Declining**	Declining
Newlingrook	Stable	Stable	Stable	**Stable**	Declining
Paaratte	Stable	Stable	Stable	**Stable**	Rising
South West Limestone (3)	-	-	Stable	**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 Bungaree WSPA status was revoked in December 2016.
(3) The South West Limestone GMA is partly contained within the Hopkins–Corangamite, Portland and Glenelg groundwater catchments.

7.5.2.2 Groundwater entitlements and use

Licensed entitlements and use for GMUs are shown in Table 7-57. Groundwater use in 2016–17 was less than the previous year, with reduced extraction in all GMUs except for Newlingrook GMA.

Table 7-57 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits(m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2016–17	Total licensed groundwater use (ML) 2015–16
Bungaree GMA (1)	All depths	5,293	2,291	3,053
Cardigan GMA	All depths	3,874	751	934
Colongulac GMA	All depths	4,406	1,244	1,735
Gerangamete GMA (2)	>60	20,000	1,546	1,846
Glenormiston GMA	<=60	2,636	1,078	1,148
Newlingrook GMA	All depths	1,958	89	60
Paaratte GMA	>120	3,212	314	367
Warrion WSPA	All depths	14,079	3,702	5,348
South West Limestone GMA, Hopkins-Corangamite (3)	See note 3	27,301	11,749	17,827
Outside management units	-	12,186	4,190	4,613
Total		**94,945**	**26,954**	**36,931**

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 level.
(3) 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 base of the limestone.

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

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 1.5 ML per bore) (ML)
Bungaree GMA	166	249
Cardigan GMA	83	125
Colongulac GMA	97	146
Gellibrand GMA	0	0
Gerangamete GMA	5	8
Glenormiston GMA	68	102
Loddon Highlands WSPA (1)	87	174
Newlingrook GMA	2	3
Paaratte GMA	2	3
South West Limestone GMA	1,271	1,907
Warrion WSPA	244	366
Outside management units	794	1,191
Total	**2,819**	**4,274**

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, 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, compared to 2015–16.

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

Town supplied	Licensed volume (ML)	Metered use 2016–17 (ML)	Metered use 2015–16 (ML)
Ballarat - Bungaree Bore	120	9	0
Ballarat West (1)	3,000	532	636
Beaufort	200	0	47
Caramut	50	31	31
Darlington	10	3	4
Dean	30	15	17
Greater Geelong (Barwon Downs borefield) (2)	20,000	1,546	1,846
Mortlake (part)	335	11	32
Otway System (Carlisle)	1,800	36	35
Port Campbell, Timboon and Peterborough	3,159	320	367
Streatham	60	25	21
Total	**28,764**	**2,528**	**3,036**

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 is also responsible for issuing licenses for groundwater use and bore construction.

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 2016–17 are shown in Table 7-60. The groundwater level trends were mostly categorised as declining throughout the year. Observation bores were identified for the Portland GMA during 2016–17 and for the South West Limestone GMA during the second half of the year.

Table 7-60 Groundwater management unit trends

Groundwater management unit	Groundwater level trend 2016–17				Groundwater level trend June 2016
	Sep-16	Dec-16	Mar-17	Jun-17	
Water supply protection area					
Condah	Declining	Declining	Declining	**Stable**	Declining
Groundwater management area					
Portland	Declining	Declining	Declining	**Declining**	-
South West Limestone (1)	-	-	Stable	**Stable**	-

Note
(1) The South West Limestone GMA is partly contained within the Hopkins–Corangamite, Portland and Glenelg groundwater catchments.

7.5.3.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs are shown in Table 7-61. Groundwater use within the catchment decreased in 2016–17, compared to 2015–16.

Table 7-61 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits(m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2016–17	Total licensed groundwater use (ML) 2015–16
Portland GMA	>200	7,794	2,389	2,693
Condah WSPA	70–200	7,470	2,666	3,123
South West Limestone GMA, Portland	See note 1	36,447	10,387	13,148
Outside management units	-	4,175	875	1,067
Total		**55,886**	**16,317**	**20,031**

Note
(1) From the top of the upper mid-tertiary limestone to 50 m below the upper mid-tertiary (or the base) of the limestone.

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

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 1.5 ML per bore) (ML)
Portland GMA	1	2
Condah WSPA	321	482
Glenelg WSPA	0	0
South West Limestone GMA	4,036	6,054
Outside management units	215	323
Total	**4,573**	**6,861**

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.

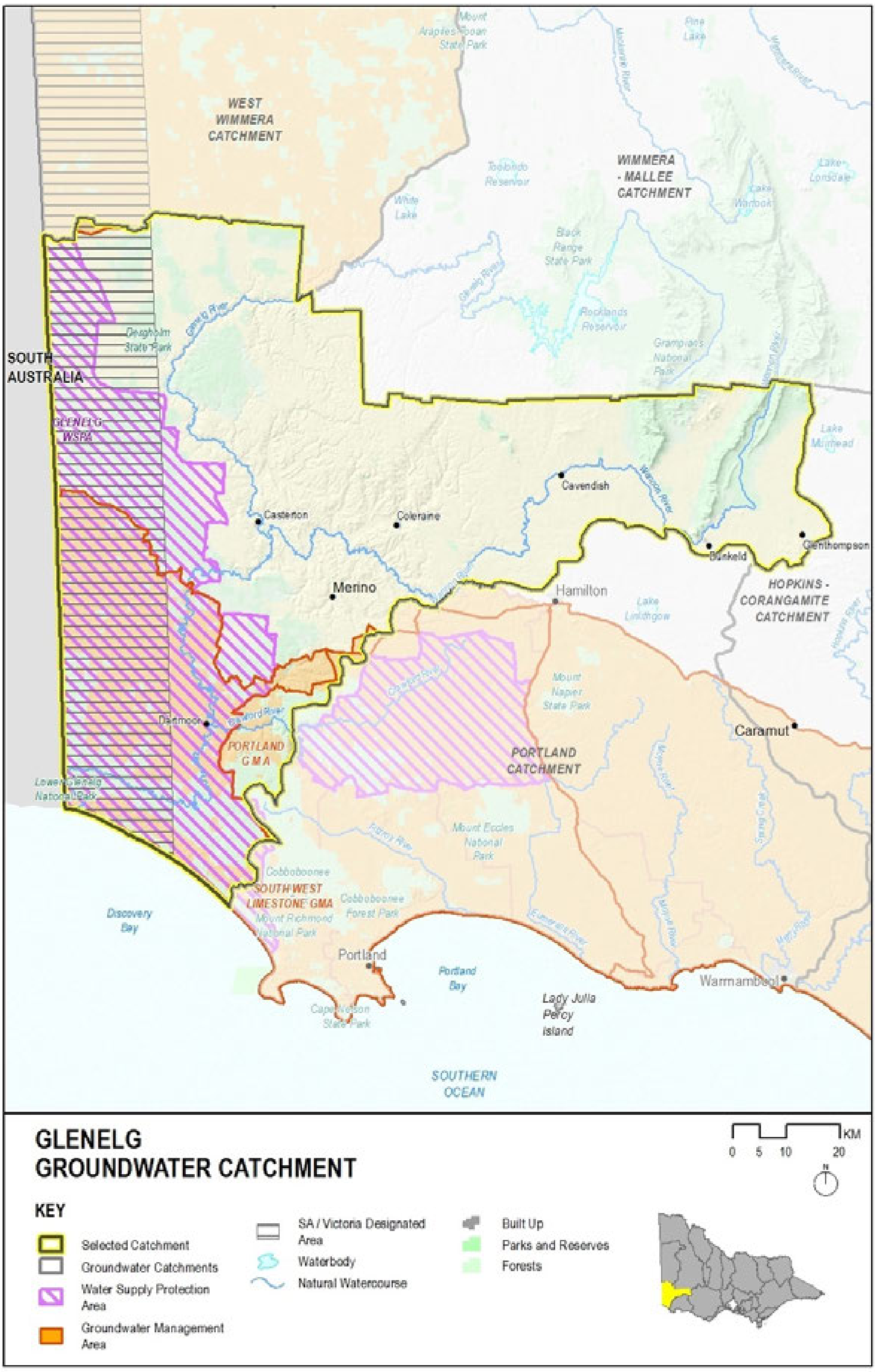
Table 7-63 Urban groundwater volumes and metered use

Town supplied	Licensed volume (ML)	Metered use 2016–17 (ML)	Metered use 2015–16 (ML)
Hamilton, Tarrington, Dunkeld	1,102	0	2
Heywood	333	110	162
Koroit	524	1	4
Macarthur	130	24	0
Penshurst	250	95	93
Port Fairy	1,026	589	633
Portland	6,222	1,717	1,898
Warrnambool, Allansford and Koroit (part)	750	314	333
Total	**10,337**	**2,850**	**3,125**

7.5.4 Glenelg groundwater catchment

The Glenelg groundwater catchment (Figure 7-18) is located in the Otway–Torquay region in western Victoria, and contains the Glenelg basin and part of the Millicent Coast basin. 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 the Portland groundwater catchment to the south-east, the Hopkins–Corangamite groundwater catchment to the east and the West Wimmera and Wimmera–Mallee groundwater catchments 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 is also responsible for issuing licenses for groundwater use and bore construction. 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 2016–17 are shown in Table 7-64. The groundwater level trend was categorised as stable throughout the year. Observation bores were identified for the South West Limestone GMA during the second half of the year.

Table 7-64 Groundwater management unit trends

Groundwater management unit	Groundwater level trend 2016–17				Groundwater level trend June 2016
	Sep-16	Dec-16	Mar-17	Jun-17	
Water supply protection area					
Glenelg	Stable	Stable	Stable	**Stable**	Declining
Groundwater management area					
South West Limestone (5)	-	-	Stable	**Stable**	-

Note
(1) The South West Limestone GMA is partly contained within the Hopkins–Corangamite, Portland and Glenelg groundwater catchments.

7.5.4.2 Groundwater entitlements and use

Licensed entitlements and use for GMUs are shown in Table 7-65. Groundwater use within the groundwater catchment decreased by about one-third in 2016–17, compared to 2015–16.

Table 7-65 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits(m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2016–17	Total licensed groundwater use (ML) 2015–16
Glenelg WSPA	All depths	15,756	3,072	5,018
South West Limestone GMA, Glenelg	See note 1	17,505	2,950	4,522
Outside management units	-	2,095	215	215
Total		**35,356**	**6,237**	**9,755**

Note
(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).

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

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 1.5 ML per bore) (ML)
Glenelg WSPA	1,065	1,598
South West Limestone GMA	63	95
Outside management units	221	332
Total	**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

Town supplied	Licensed volume (ML)	Metered use 2016–17 (ML)	Metered use 2015–16 (ML)
Casterton	1,000	362	445
Dartmoor	150	17	25
Merino	100	0	0
Total	**1,250**	**379**	**470**

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.

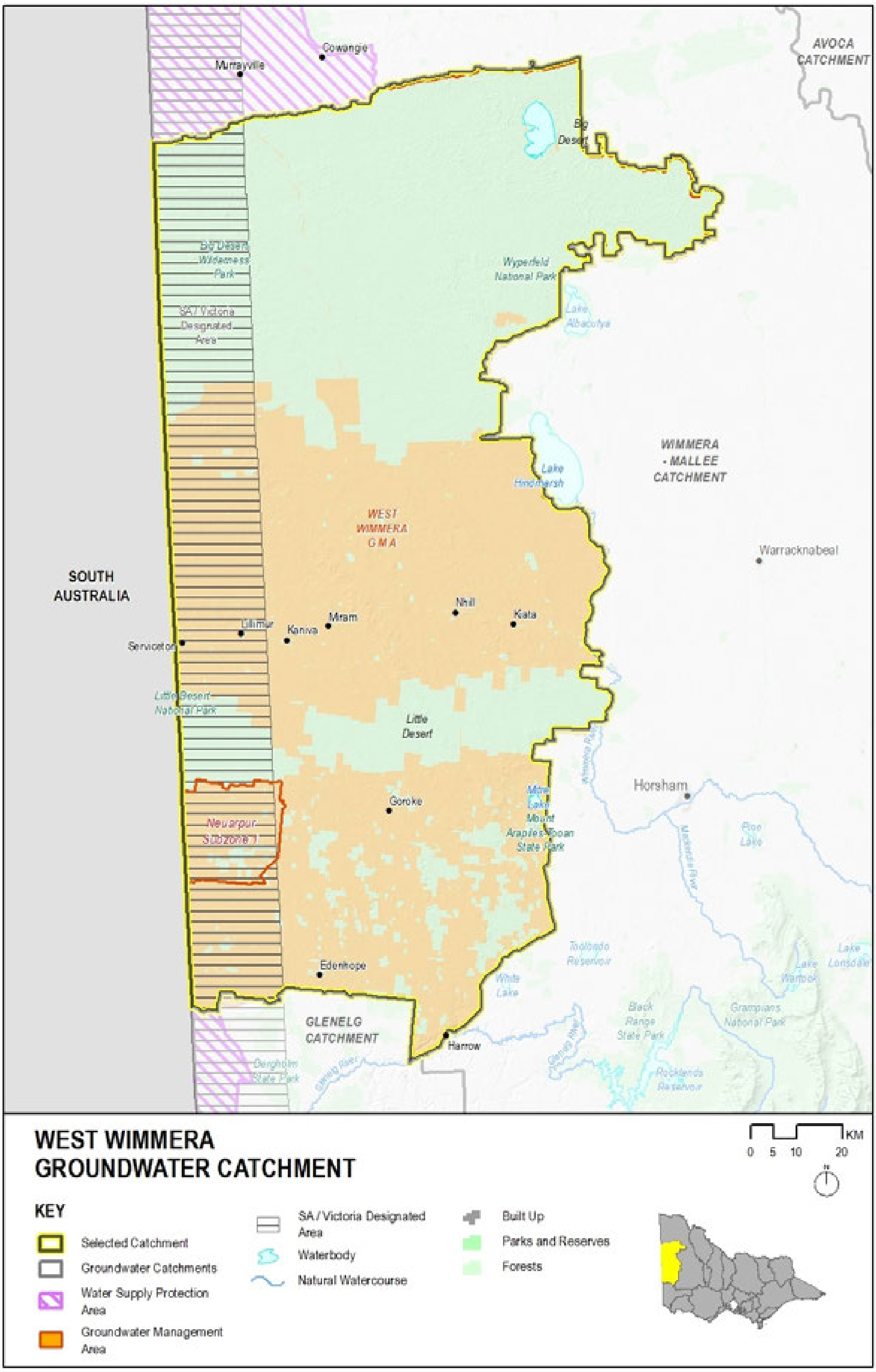
In most areas, all the aquifers are considered to be connected, with thin aquitards between the aquifers in part or all of the catchment. The Renmark Group Aquifer in the West Wimmera GMA is the exception: it is considered to be disconnected from the water above it.

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 and contains portions of the Mallee, Wimmera and Millicent Coast river basins. 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 the Wimmera–Mallee groundwater catchment to the east and north and the Glenelg groundwater catchment 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 licenses for groundwater use and bore construction, and for surface water licensed diversions. 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 supply license entitlements, domestic and stock use and Apsley, Harrow, Miram, Serviceton, Edenhope, Kiata, Goroke, Lillimur, Kaniva and Nhill.

The groundwater level trends for 2016–17 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 Groundwater management unit trends

Groundwater management unit	Groundwater level trend 2016–17				Groundwater level trend June 2016
	Sep-16	Dec-16	Mar-17	Jun-17	
Groundwater management area					
West Wimmera	Stable	Stable	Stable	Stable	Stable

7.6.1.2 Groundwater entitlements and use

Licensed entitlements and use from GMUs within the West Wimmera groundwater catchment are shown in Table 7-69. Groundwater use within the catchment increased slightly in 2016–17, compared to 2015–16.

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% seasonal allocation remained in place in the Neuarpur subzone 1 — a trading zone in the West Wimmera GMA — in 2016–17.

Table 7-69 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits(m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2016–17	Total licensed groundwater use (ML) 2015–16
West Wimmera GMA	All depths	53,372	24,428	22,658
Total		**53,372**	**24,428**	**22,658**

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

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 2.0 ML per bore) (ML)
West Wimmera GMA	638	1,276
Outside management units	1	2
Total	**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

Town supplied	Licensed volume (ML)	Metered use 2016–17 (ML)	Metered use 2015–16 (ML)
Apsley	40	10	29
Edenhope	250	133	227
Goroke	86	45	61
Harrow (1)	29	33	41
Kaniva	600	173	234
Kiata	40	5	6
Lillimur	32	7	9
Miram	7	1	1
Nhill	1,000	120	221
Serviceton	25	10	8
Total	**2,109**	**537**	**837**

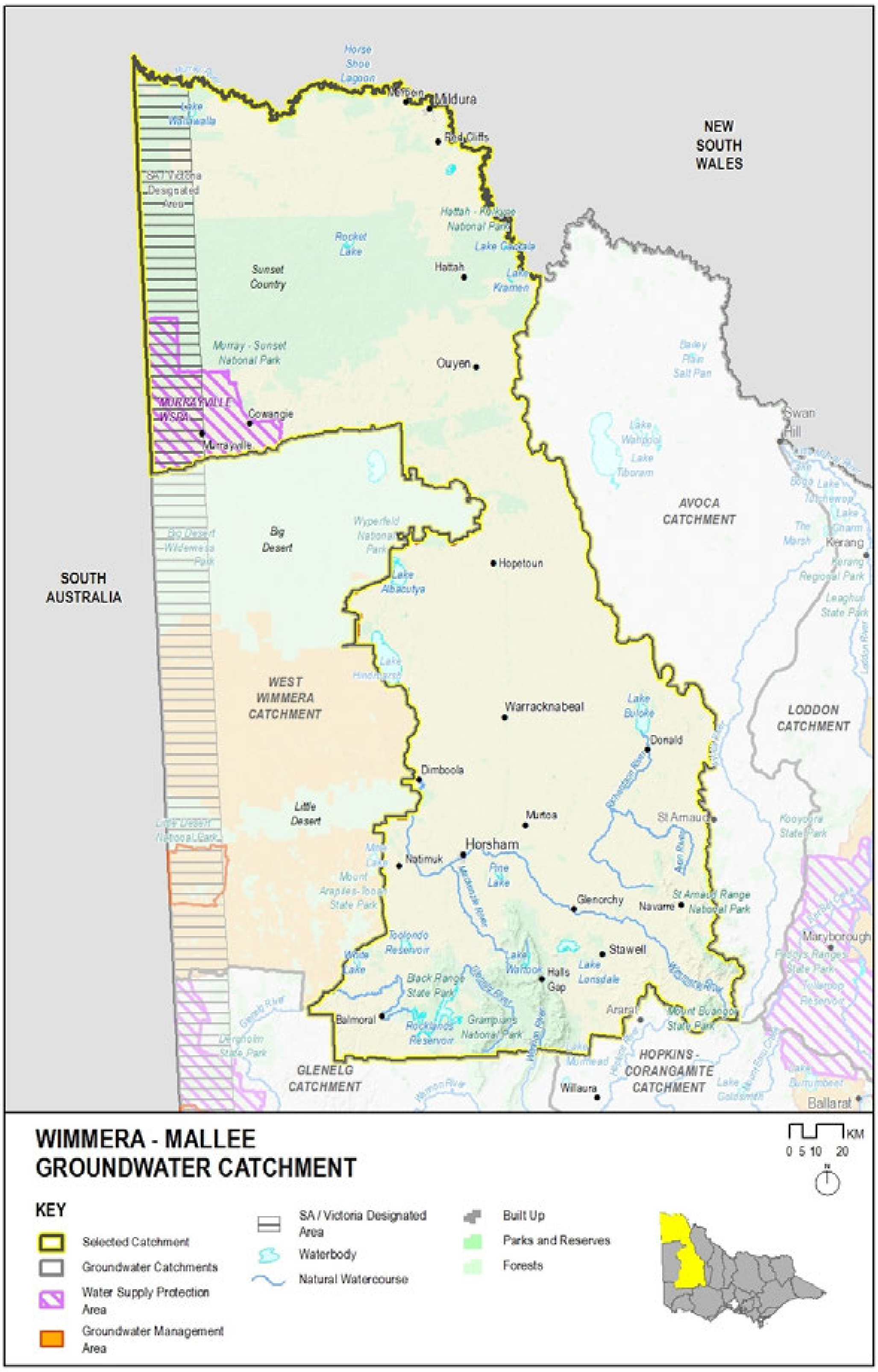
Note

(1) Usage exceeded licensed volume in Harrow. 3 ML of unused water from the previous year was available for use in 2016–17.

7.6.2 Wimmera–Mallee groundwater catchment

The Wimmera–Mallee groundwater catchment (Figure 7-20) is located in north-western Victoria and overlaps the Mallee river basin in the north and the Wimmera river basin in its south. Neighbouring groundwater catchments are the West Wimmera groundwater catchment to the west, the Avoca groundwater catchment to the east and the Glenelg and Hopkins–Corangamite groundwater catchments 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 and bore construction, as well as for surface water diversions. 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 WSPA. 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 2016–17 are shown in Table 7-72. In 2016–17, the groundwater level trend in the Murrayville WSPA was categorised as stable.

Table 7-72 Groundwater management unit trends

Groundwater management unit	Groundwater level trend 2016–17				Groundwater level trend June 2016
	Sep-16	Dec-16	Mar-17	Jun-17	
Water supply protection area					
Murrayville	Stable	Stable	Stable	Stable	Stable

7.6.2.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs are shown in Table 7-73. There was slightly less groundwater use within the catchment in 2016–17, compared to 2015–16.

Table 7-73 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits(m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2016–17	Total licensed groundwater use (ML) 2015–16
Murrayville WSPA	70–200	9,634	5,805	6,131
Outside management units	-	10,871	458	341
Total		**20,505**	**6,263**	**6,472**

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

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 2.0 ML per bore) (ML)
Murrayville WSPA	185	370
Outside management units	258	516
Total	**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

Town supplied	Licensed volume (ML)	Metered use 2016–17 (ML)	Metered use 2015–16 (ML)
Cowangie	40	9	13
Horsham Mt Zero	1,200	21	0
Landsborough	150	32	44
Murrayville	475	100	133
Willaura system	220	146	0
Total	**2,085**	**308**	**190**

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 in Mafeking.

7.6.3 Avoca groundwater catchment

The Avoca groundwater catchment is in north-western Victoria (Figure 7-21) and contains the Avoca river basin and a portion of the Wimmera-Avon basin. Neighbouring groundwater catchments are the 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 licenses for groundwater use and bore construction, and for surface water licensed diversions. Central Highlands Water 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.

7.6.3.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from across the groundwater catchment are shown in Table 7-76. Groundwater use within the catchment decreased in 2016–17, compared to 2015–16.

Table 7-76 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits(m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2016–17	Total licensed groundwater use (ML) 2015–16
Outside management units	-	2,572	607	499
Total		**2,572**	**607**	**499**

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

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 2 ML per bore) (ML)
Outside management units	63	126
Total	**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 2016–17, compared to 2015–16.

Table 7-78 Urban groundwater volumes and metered use

Town supplied	Licensed volume (ML)	Metered use 2016–17 (ML)	Metered use 2015–16 (ML)
Amphitheatre	20	1	0
Avoca	250	176	198
Redbank	50	3	0
Total	**320**	**180**	**198**

8. Distribution system water accounts

8.1 Overview of 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 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:

- 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:

- 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:

- systems that consolidate 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 common-sense 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 107,000 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	Bright system – Bright, Wandiligong and Porepunkah	Unregulated Ovens River	Bright
	Harrietville	Simmons Creek and unregulated Ovens River	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
Central	Goorambat	Groundwater	Goorambat
King and Ovens rivers	Moyhu	Regulated King River	Moyhu
	Oxley	Regulated King River	Oxley
	Wangaratta and Glenrowan	Regulated Ovens River, groundwater	Wangaratta
	Whitfield	Musk Gully Creek	Whitfield
Mitta Mitta River	Dartmouth	Mt Tabor Creek	Dartmouth
	Eskdale	Regulated Mitta Mitta River	Eskdale
Murray River	Bellbridge	Lake Hume	Bellbridge
	Tallangatta	Lake Hume	Tallangatta
	Wahgunyah system – Wahgunyah and Rutherglen	Regulated Murray River	Wahgunyah
	Wodonga system – Wodonga, Baranduda, Kiewa, Springhurst, Tangambalanga, Bonegilla, Ebden, Barnawartha and Chiltern	Regulated Murray River	Wodonga
	Yarrawonga system – Yarrawonga, Tungamah, St James and Devenish	Regulated Murray River	Yarrawonga
Subalpine	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	Walwa

Table 8-2 summarises shows North East Water's urban distribution systems' water balances.

Table 8-2 North East 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	Total outflows		
Alpine area								
Bright system	58	906	287	145	457	889	76	49%
Harrietville	0.4	57.7	25.3	18.0	14.4	57.7	0.3	75%
Mount Beauty system	5	275	159	56	64	278	2	77%
Myrtleford (1)	323	577	273	212	109	594	306	82%
Broken River								
Benalla	9	1,494	877	319	298	1,493	9	80%
Kings and Ovens rivers								
Moyhu	0.1	33.0	18.7	4.9	9.4	33.1	0.1	71%

Oxley	0.2	60.9	31.2	0.9	28.7	60.8	0.2	53%
Wangaratta system	25	3,556	1,748	1,244	560	3,553	29	84%
Whitfield	0.2	17.4	11.3	4.6	1.5	17.4	0.2	91%
Mitta Mitta River								
Dartmouth	0.3	26.7	15.1	5.9	5.8	26.8	0.2	79%
Eskdale	0.2	11.0	6.3	4.1	0.5	11.0	0.1	96%
Murray River								
Bellbridge	0.6	53.7	36.5	2.1	15.1	53.6	1	72%
Rutherglen/Wahgunyah system	7	667	382	165	120	667	6	82%
Tallangatta	2	165	77	44	45	165	2	73%
Wodonga system	74	6,604	3,646	2,102	841	6,590	88	87%
Yarrawonga system	12	1,415	959	174	284	1,416	11	80%
Sub-alpine area								
Beechworth (1)	817	761	294	166	460	920	658	50%
Yackandandah	27	214	76	41	99	217	24	54%
Upper Murray River								
Corryong system	90	251	116	49	100	265	76	62%
Walwa (2)	1	23	8	11	5	23	1	n/a
Supplied from groundwater								
Goorambat	0	10	9	1	0	10	0	100%

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.

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 Shepparton Irrigation Area – Dookie and Katandra West	Shepparton Irrigation Area	At each town
	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
Goulburn River and tributaries	Alexandra	Regulated Goulburn River	Alexandra
	Murchison	Regulated Goulburn River	Murchison
	Nagambie (includes Kirwan's Bridge)	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
	Broadford system – Broadford and Waterford Park (Clonbinane)	Sunday Creek Reservoir and regulated Goulburn River at Tallarook	Broadford
	Euroa system – Euroa, Strathbogie and Violet Town	Mountain Hut Creek and 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 and Buxton	Steavenson River	Marysville
	Pyalong	Mollisons Creek	Pyalong
	Thornton	Rubicon River	Thornton

	Upper Delatite system – Sawmill Settlement and Merrijig	Delatite River	Sawmill Settlement
	Woods Point	Brewery Creek	Woods Point
	Yea and Molesworth	Yea River	Yea
Lake Eildon	Bonnie Doon and Eildon	Brankeet Creek / Lake Eildon	Bonnie Doon
Murray channels	Katamatite and Picola	Murray Valley Irrigation Area	At each town
	Numurkah system – Numurkah and Wunghnu	Murray 6/6 Channel	Numurkah
Murray River	Barmah	Murray River	Barmah
	Cobram system – Cobram, Strathmerton and Yarroweyah	Murray River	Cobram
Supplied from groundwater	Katunga		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

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 (2)	Total outflows		
Broken Creek									
Nathalia	0	577	211	78	287	0	577	0	50%
Goulburn channels									
Towns supplied from Central Goulburn IA	638	4,784	1,597	2,597	584	0	4,778	644	88%
Towns supplied from Rochester IA	0	34	15	5	13	0	34	0	60%
Towns supplied from Shepparton IA	0	134	51	34	48	0	134	0	64%
Goulburn River and tributaries									
Alexandra	0	529	210	80	59	180	529	0	89%
Murchison	0	167	90	35	41	0	167	0	75%
Nagambie system	0	526	202	274	50	0	526	0	90%
Seymour system	0	1,449	820	325	304	0	1,449	0	79%
Shepparton system	0	11,058	5,654	3,766	1,639	0	11,058	0	85%
Woods Point	0	7.4	4	2	1.7	0	7	0	77%
Broadford system	61	678	389	105	141	0	635	104	78%
Euroa system	439	861	422	148	70	0	640	660	89%
Kilmore system	64	1,440	693	144	604	0	1,441	63	58%
Longwood	27	59	32	11	17	0	59	27	72%
Mansfield	397	944	316	128	336	0	780	561	57%
Marysville and Buxton	93	280	74	39	163	0	276	97	41%
Pyalong	13	67	29	8	6	0	43	37	86%
Thornton	0	42	25	10	7	0	42	0	83%
Upper Delatite system	0	108	61	25	22	0	108	0	79%
Yea system	0	217	139	52	26	0	217	0	88%
Lake Eildon									
Eildon and Bonnie Doon	46	207	107	41	56	0	205	48	72%
Murray channels									
Katamatite and Picola	16	1,044	19	32	81	912	1,044	16	92%
Numurkah system (1)	0	912	565	361	(14)	0	912	0	n/a
Murray River									
Barmah	0	53	22	8	23	0	53	0	56%
Cobram system	0	2,890	677	1,674	539	0	2,890	0	81%
Supplied from groundwater									
Katunga	0	67	23	15	30	0	67	0	56%

Notes

(1) Goulburn Valley Water has reported a negative loss in this system. This infers there is some uncertainty around the figures. Due to this uncertainty, no efficiency measure has been reported in the system for this year.
(2) *'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).

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 (WWC) 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 WWC. 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 WWC. 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)	Eliminations (ML)	Total (ML)
Volumes in store					
Start volume in store (1 July 2016)					
Waranga basin	226,768				226,768
Greens Lake		17,862			17,862
End volume in store (30 June 2017)					
Waranga basin	227,274				227,274
Greens Lake		22,599			22,599
Change in storage	**506**	**4,737**			**5,243**
Inflows					
From Goulburn River	530,411				530,411
Rainfall on Waranga basin	33,003				33,003
From WWC Goulburn segment		259,633		(259,633)	0
From Cornella Creek					0
Rainfall on Greens Lake		2,839			2,839
From WWC Campaspe segment			125,406	(125,406)	0
From Loddon River			317,886		317,886
Unattributed inflows					0
Total inflows	**563,414**	**262,472**	**443,292**	**(385,039)**	**884,139**
Outflows					
Passed to other systems					0
To Central Goulburn Irrigation area	232,413				232,413
To Goldfields superpipe					0
To WWC Campaspe segment	259,633			(259,633)	0
To Rochester Irrigation Area		127,267			127,267
To WWC Loddon segment		125,406		(125,406)	0
To Loddon Valley Irrigation Area			134,987		134,987
To Campaspe River					0
To Loddon River			308,305		308,305
Total passed to other systems	**492,046**	**252,673**	**443,292**	**(385,039)**	**802,972**
Losses					
Evaporation from Waranga basin	63,356				63,356
Evaporation from Greens Lake		5,062			5,062
Unattributed Outflows	7,506				7,506

Total losses	70,862	5,062	0		75,924
Total outflows	562,908	257,735	443,292	(385,039)	878,896

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 (VMMS)	Volume (ML)
Volumes in store	
Start volume in store (1 July 2016)	
Total Kow Swamp, Lake Charm, Kangaroo Lake, Lake Boga	108,566
End volume in store (30 June 2017)	
Total Kow Swamp, Lake Charm, Kangaroo Lake, Lake Boga	117,817
Change in storage	**9,251**
Inflows	
Rain on all storages	22,262
Inflows from Torrumbarry Irrigation Area	291,989
Total inflows	**314,251**
Outflows	
Passed to other systems	
Lake Charm to Murray River	2,947
Lake Boga to Murray River	0
6/7 channel to Murray River	66,712
Kerang Weir to Murray River	175,293
Total passed to other systems	**244,952**
Losses	
Evaporation on storages	48,606
System losses (1)	11,442
Total losses	**60,048**
Total outflows	**305,000**

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
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	-	232,413	213,175	0	14,834	4,404	232,413	-	94%
Murray Valley Irrigation Area	-	244,290	168,099	0	22,208	53,983	244,290	-	91%
Nyah Irrigation Area	-	4,931	4,887	0	44	0	4,931	-	99%
Loddon Valley Irrigation Area	-	134,987	111,917	0	21,431	1,639	134,987	-	84%
Rochester Irrigation Area	-	127,267	109,136	0	17,065	1,066	127,267	-	87%
Shepparton Irrigation Area	-	140,632	85,338	0	13,460	41,834	140,632	-	90%
Torrumbarry Irrigation Area	13,094	610,310	225,876	47,945	51,552	284,306	609,679	13,725	92%
Tresco Irrigation Area	-	5,294	5,187	0	107	0	5,294	-	98%
Woorinen Irrigation Area	-	13,202	9,302	392	3,508	0	13,202	-	73%
Other rural distribution systems									
East Loddon D&S	-	562	0	499	63	0	562	-	89%
Normanville D&S	62	365	0	166	110	97	373	54	70%
Tungamah D&S (1)	-	368	0	303	65	0	368	-	82%
West Loddon D&S	-	216	0	216	0	0	216	-	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 90% efficiency.

8.3.4 Coliban Water

Coliban Water provides water and wastewater services to about 146,000 people in 49 localities across central and northern Victoria. The largest localities it services 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 2016)	
End volume in store (30 June 2017)	
Change in storage	**-**
Inflows	
From Lake Eppalock - Coliban Water	803
From Lake Eppalock - Central Highlands Water	-
From Waranga Western Channel at Colbinabbin - Coliban Water	-
From Waranga Western Channel at Colbinabbin - Central Highlands Water	-
From Sandhurst Reservoir (1)	2,330
Total inflows	**3,133**
Outflows	
Direct deliveries to rural customers	**1,301**
Passed to other systems	
To Emu Valley rural channel sub-system	105
To Axe Creek rural channel sub-system	281
To Specimen Hill rural channel sub-system	54
Transfer to Central Highlands Water (to White Swan Reservoir)	-
To Heathcote urban system (Caledonia Reservoir)	-
To Sandhurst Reservoir-Coliban Water	-
To Spring Gully Reservoir	1,347
Total passed to other systems	**1,787**
Losses	**45**
Total outflows	**3,133**
System efficiency (%)	**57%**

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 2016)	0
End volume in store (30 June 2017)	0
Change in storage	**-**
Inflows	
From Malmsbury reservoir	18,613
Total inflows	**18,613**
Outflows	
Deliveries to customers	
Direct deliveries to rural customers	266
Total deliveries to customers	**266**
Passed to other systems	
To Coliban North system at Sandhurst Reservoir	12,527
To Poverty Gully rural sub-system	1,792
To Harcourt rural sub-system	403

To Emu Valley rural Sub-system	831
To Spring Gully rural sub-system	153
To Specimen Hill rural sub-system	1,166
Total passed to other systems	**16,872**
Losses	
System losses (1)	1475
Total losses	**1,475**
Total outflows	**18,613**
System efficiency (%)	**92%**

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. Table 8-11 shows Coliban Water's rural distribution systems' water balances.

Table 8-11 Coliban 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	System losses	Passed to other systems	Total outflows		
Ascot	0	730	531	199	0	730	0	73%
Axe Creek	0	281	90	192	0	281	0	32%
Cockatoo Hill	0	420	188	232	0	420	0	45%
Emu Valley	0	936	379	557	0	936	0	40%
Harcourt	1,520	960	576	933	0	1,509	971	38%
Jackass Flat	0	33	7	26	0	33	0	20%
Lockwood	0	751	408	343	0	751	0	54%
Poverty Gully	0	1,792	20	428	1,344	1,792	0	76%
Specimen Hill	0	1,501	540	211	751	1,501	0	91%
Spring Gully Reservoir	1,271	2,912	0	1,989	1,150	3,139	1,044	37%
Spring Gully (1)	0	153	71	(12)	93	153	0	n/a

Note

(1) Coliban 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.

In some rural distribution systems, customers have relinquished their licences due to urban encroachment. This is particularly true for Jackass Flat, and has led to low efficiencies in channels in this area during 2016–17.

8.3.4.4 Urban distribution systems

Table 8-12 summarises Coliban Water's urban distribution systems.

Table 8-12 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 and Tooborac	Lake Eppalock and the Goulburn system (via Goldfields Superpipe)	Heathcote
Coliban Southern	Castlemaine system – 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

Elmore groundwater	Elmore	Lower Campaspe Valley Water Supply Protection Area	Elmore
Goulburn	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
Loddon	Bridgewater system – Bridgewater and Inglewood	Loddon River	Bridgewater
	Jarklin	Loddon River – Serpentine Creek and tankered	No treatment (not a drinking water supply)
	Laanecoorie system – Laanecoorie, Tarnagulla, Bealiba and Dunolly	Loddon River	Laanecoorie
	Serpentine	Loddon River – Serpentine Creek and tankered	Serpentine
Murray	Cohuna rural 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
Trentham Groundwater	Trentham	Spring water and groundwater from Campaspe basin	Trentham
Wimmera	Borung	Wimmera Mallee Pipeline	No treatment (not a drinking water supply)
	Korong Vale and Wedderburn	Wimmera Mallee Pipeline	Korong Vale
	Wychitella	Wimmera Mallee Pipeline	No treatment (not a drinking water supply)

Table 8-13 shows Coliban Water's urban distribution systems' water balances.

Table 8-13 Coliban 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 [1]	Passed to other systems	Total outflows		
Campaspe									
Goornong	0	58	28	9	21	0	58	0	63%
Coliban Northern									
Bendigo system	2,595	13,521	7,881	2,841	1,689	2,330	14,741	1,375	89%
Heathcote system	194	474	148	78	262	0	488	181	46%
Coliban Southern									
Castlemaine system - McKay Reservoir [2]	1,026	1,677	1,098	836	138	0	2,072	631	93%
Kyneton system	0	916	457	366	93	0	916	0	90%
Goulburn system									
Supplied from PH-Boort Irrigation Area [3]	0	407	157	71	179	0	407	0	56%
Supplied from Rochester Irrigation Area [4]	0	1,207	375	639	193	0	1,207	0	84%
Jarklin	0	1	1	0	0	0	1	0	100%
Serpentine	0	32	12	3	17	0	32	0	47%
Loddon system									
Bridgewater system	0	224	84	48	92	0	224	0	59%
Laanecoorie system	0	116	71	22	23	0	116	0	80%
Murray system									
Cohuna	0	767	304	250	213	0	767	0	72%
Echuca	0	3,118	1,563	1,170	385	0	3,118	0	88%
Gunbower	0	58	33	13	12	0	58	0	79%
Leitchville	0	240	43	108	89	0	240	0	63%

Wimmera system									
Borung [6]	0	4	4	0	0	0	4	0	100%
Koorong Vale - Wedderburn	0	194	72	29	93	0	194	0	52%
Wychitella	0	1	1	0	0	0	1	0	100%
Supplied by groundwater									
Elmore	0	96	57	31	8	0	96	0	91%
Trentham [5]	61	111	67	20	4	0	91	81	95%

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.
(6) 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.

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 8-14 summarises Lower Murray Water's rural distribution systems.

Table 8-14 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 8-15 shows Lower Murray Water's rural distribution systems' water balances.

Table 8-15 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	33,968	30,224	60	3,684	0	33,968	0	89%
Merbein Irrigation District	0	18,695	16,891	0	1,804	0	18,695	0	90%
Red Cliffs Irrigation District	0	27,241	23,792	0	3,449	0	27,241	0	87%
Robinvale Irrigation District	0	18,277	18,277	0	0	0	18,277	0	100%

Other rural distribution systems									
Millewa water works district [2]	120	1,071	834	0	185	53	1,071	120	78%
Yelta water works district	0	4,895	4,895	0	0	0	4,895	0	100%

Note
(1) 'Other deliveries' 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 8-16 summarises Lower Murray Water's urban distribution systems.

Table 8-16 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 Storage (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 8-17 shows Lower Murray Water's urban distribution systems' water balances.

Table 8-17 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	984	667	165	152	984	6	85%
Koondrook	3	232	156	18	58	232	3	75%
Mildura system	48	12,624	8,555	2,501	1,568	12,624	48	88%
Millewa system	0	53	53	0	0	53	0	100%
Murrabit	2	35	18	7	9	35	2	73%
Mystic Park	0	11	6	1	5	11	0	57%
Piangil	1	126	40	53	33	126	1	73%
Red Cliffs	7	1,210	606	456	148	1,210	7	88%
Robinvale	5	580	373	152	55	580	5	91%
Swan Hill system	14	3,914	2,502	847	565	3,914	14	86%

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 8-18 summarises East Gippsland Water's urban distribution systems.

Table 8-18 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 8-19 shows East Gippsland Water's urban distribution systems' water balances.

Table 8-19 East Gippsland 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	Total outflows		
Bemm River	5	25	8	7	10	25	4	59%
Buchan	0	25	11	8	6	25	0	76%
Cann River	3	37	14	14	10	38	2	73%
Dinner Plain	0	41	20	7	14	41	0	66%
Mallacoota	51	160	95	48	14	157	55	91%
Mitchell system	1,086	4,699	2,605	1,175	764	4,544	1,241	84%
Omeo	6	70	26	22	18	66	10	76%
Orbost system	19	669	243	337	52	632	56	92%
Swifts Creek (1)	4	35	14	17	5	36	3	n/a

Note

(1) 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.

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 8-20 summarises Gippsland Water's urban distribution systems.

Table 8-20 Gippsland Water urban distribution systems

Area	System / towns supplied	Source of supply	Treatment plant location / comment
Macalister–Thomson	Maffra system – Boisdale, Maffra and Stratford	Macalister River	Maffra
	Coongulla system – Coongulla and Glenmaggie	Lake Glenmaggie	Coongulla
	Heyfield	Thomson River	Heyfield
	Briagalong	Groundwater	Briagalong

Moe	Moe system – Moe, Newborough, Yallourn North, Trafalgar, Darnum, Yarragon and Thorpdale	Narracan Creek and Tanjil River	Moe
Moondarra Reservoir	Moondarra system – Boolarra, Churchill, Cowwarr, Glengarry, Hazelwood North, Jumbuck, Morwell, Rosedale, Toongabbie, Traralgon, Tyers and Yinnar	Moondarra Reservoir	Morwell, Traralgon and Tyers
Sale	Sale and Wurruk	Groundwater	Sale
Warragul–Drouin	Warragul system – Buln Buln, Drouin, Nilma, Warragul and Warragul South	Tarago River	Warragul
Small towns in Latrobe and South Gippsland basins	Boolarra	Walkleys / O'Gradys Creek	Boolarra
	Erica and Rawson	Trigger Creek	Rawson
	Mirboo North	Little Morwell River	Mirboo North
	Neerim South and Noojee	Tarago Reservoir	Neerim South
	Seaspray	Merrimans Creek	Seaspray
	Willow Grove	Blue Rock Reservoir	Willow Grove

Table 8-21 shows Gippsland Water's urban distribution systems' water balances.

Table 8-21 Gippsland 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		Losses		Total outflows		
			To urban residential	To urban non-residential (1)	From treatment plants	From distribution systems			
Erica/Rawson	33	55	34	17	1	3	55	33	92%
Macalister / Thomson area	42	1,477	802	461	54	164	1,480	39	86%
Mirboo North	2	217	114	29	4	69	217	2	66%
Moe system (2)	51	3,791	1,650	1,745	75	319	3,789	52	90%
Moondarra Reservoir system	725	48,087	4,408	42,188	386	1,122	48,104	708	97%
Neerim South/ Noojee	3	212	132	29	3	47	211	3	77%
Sale system	20	1,846	1,155	472	65	155	1,848	18	88%
Seaspray	3	34	20	8	2	4	34	3	81%
Warragul/Drouin system	66	3,580	2,009	626	250	682	3,567	80	74%
Willow Grove	0	39	27	1	3	9	39	0	71%

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 not 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.

Table 8-22 shows the water balance for the Macalister Irrigation District.

Table 8-22 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	185,908	146,552	34,268	5,088	185,908	0	97%

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 8-23 summarises South Gippsland Water's urban distribution systems.

Table 8-23 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 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 8-24 shows South Gippsland Water's urban distribution systems' water balances.

Table 8-24 South Gippsland 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	Total outflows		
Dumbalk	-	20	10	5	5	20	-	75%
Fish Creek	-	120	12	58	50	120	-	58%
Foster	-	170	71	53	46	170	-	73%
Korumburra	-	877	247	382	248	877	-	72%
Leongatha	-	1,715	391	1,165	159	1,715	-	91%
Loch system	-	230	80	78	72	230	-	69%
Meeniyan	-	60	33	16	11	60	-	82%
Toora system	-	511	70	210	231	511	-	55%
Wonthaggi system	-	1,527	968	387	172	1,527	-	89%
Yarram system	-	459	146	201	112	459	-	76%

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 8-25 summarises Westernport Water's distribution system's water balances.

Table 8-25 Westernport Water distribution system's water balance

Westernport Water	Volume (ML)
Volumes in store	
Start volume in store (1 July 2016)	-
End volume in store (30 June 2017)	-
Change in storage	**-**
Inflows	
From Candowie Reservoir	2,054
From Bass River	129
Recycled water	75
Total inflows	**2,258**
Outflows	
Deliveries	
To residential customers	1,179
To non-residential customers	747
Total deliveries	**1,926**
Losses	
System losses	332
Total losses	**332**
Total outflows	**2,258**
System efficiency (%)	**85%**

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 8-26 summarises Melbourne Water's distribution system's water balance.

Table 8-26 Melbourne Water distribution system's water balance

Melbourne Water	Volume (ML)
Volumes in store (1)	
Start volume in store (1 July 2016)	
Silvan Reservoir	35,962
Cardinia Reservoir	181,593
Sugarloaf Reservoir	65,804
Greenvale Reservoir	21,492
Total start volume	**304,851**

End volume in store (30 June 2017)	
Silvan Reservoir	35,157
Cardinia Reservoir	189,355
Sugarloaf Reservoir	67,018
Greenvale Reservoir	22,632
Total end volume	**314,162**
Change in storage	**9,311**
Inflows	
From Yarra basin to Silvan	277,398
From Yarra basin to Sugarloaf	108,131
From Goulburn River to Sugarloaf	0
From Tarago Reservoir	13,434
Rainfall on four main storages	17,398
Unaccounted for inflow	39,914
Total inflows	**456,275**
Outflows	
Passed to other systems	
To South East Water	152,475
To Yarra Valley Water	150,124
To City West Water	113,195
To Western Water	10,443
To Gippsland Water	1,030
To Cardinia Creek from Cardinia	1,825
To Stonyford Creek from Silvan	730
Total passed to other systems	**429,822**
Losses	
Evaporation from four main storages	16,203
System losses	939
Total losses	**17,142**
Total outflows	**446,964**
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 8-27 shows South East Water's urban distribution system's water balance.

Table 8-27 South East Water urban distribution system's water balance

South East Water	Volume (ML)
Volumes in store	
Start volume in store (1 July 2016)	523
End volume in store (30 June 2017)	523
Change in storage	**0**
Inflows	
From Melbourne Water	152,655
Recycled water - imported from bulk supplier	1,719
Recycled water - imported from local treatment plant	3,774
Unaccounted for inflow	4,765
Total inflows	**162,913**
Outflows	
Deliveries	
To residential customers	102,772
To non-residential customers	35,862
Non-revenue consumptive delivery	5,802
Recycled water used	5,493
Total deliveries	**149,929**
Losses	

System losses [1]	12,984
Total losses	**12,984**
Total outflows	**162,913**
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 8-28 shows Yarra Valley Water's urban distribution system's water balance.

Table 8-28 Yarra Valley Water urban distribution system's water balance

Yarra Valley Water	Volume (ML)
Volumes in store	
Start volume in store (1 July 2016)	-
End volume in store (30 June 2017)	-
Change in storage	**-**
Inflows	
From Melbourne Water	150,124
Total inflows	**150,124**
Outflows	
Deliveries	
To residential customers	107,931
To non-residential customers	27,748
Non-revenue consumptive delivery	2,495
Total deliveries	**138,174**
Losses	
System losses	11,950
Total losses	**11,950**
Total outflows	**150,124**
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 8-29 shows City West Water's urban distribution system's water balance.

Table 8-29 City West Water urban distribution system's water balance

City West Water	Volume (ML)
Volumes in store	
Start volume in store (1 July 2016)	-
End volume in store (30 June 2017)	-
Change in storages [1]	-
Inflows	
Inflows from Melbourne Water	113,186
Recycled water - imported from bulk supplier	367
Unaccounted for inflow	4,945
Total inflows	**118,498**
Outflows	
Deliveries	
To residential customers	59,537
To non-residential customers	45,794
Recycled water used	2,581
Non-revenue consumptive delivery	2,731
Total deliveries	**110,643**
Losses	
System losses	7,855
Total losses	**7,855**
Total outflows	**118,498**
System efficiency	**93%**

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 8-30 summarises Western Water's urban distribution systems.

Table 8-30 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 8-31 shows Western Water's urban distribution systems' water balances.

Table 8-31 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	1,334	15,412	10,552	1,965	2,095	0	14,612	2,135	86%
Myrniong (1)	-	45	32	6	8	0	45	-	83%

Note

(1) Pykes 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 8-32 summarises Barwon Water's urban distribution systems.

Table 8-32 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
Greater Geelong and Bellarine Peninsula system	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	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
	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	Anglesea borefield – Lower Eastern View formation	At bores

Lorne	Lorne	Allen Reservoir on the St George River, west of Lorne	Lorne

Table 8-33 shows Barwon Water's urban distribution systems' water balances.

Table 8-33 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 (%)
			To urban residential	To urban other	System losses	Total outflows		
Apollo Bay	369	368	191	106	82	380	357	78%
Colac system	493	3,352	1,308	1,233	659	3,200	645	79%
Geelong/Bellarine	18,535	42,805	20,695	7,891	4,194	32,780	28,561	87%
Lorne	0	420	213	92	114	420	0	73%

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 8-34 summarises Central Highlands Water's urban distribution systems.

Table 8-34 Central Highlands Water urban distribution systems

Area	System / towns supplied	Source of supply	Treatment plant location / comment
Greater Ballarat (multiple basins)	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 in the Barwon basin, Lal Lal Reservoir in the Moorabool basin, Ballarat West groundwater bores and the Goldfields Superpipe which extracts water from the Goulburn basin	Water filtration plants at White Swan and Lal Lal reservoirs
Maryborough and district (Loddon basin)	Maryborough system – Adelaide Lead, Alma/Moonlight, Betley, Carisbrook, Craigie, Daisy Hill, Havelock, Majorca, Maryborough, Rodborough, Simson/Bet Bet, Talbot and Timor/Bowenvale	Evansford and Talbot reservoirs (which source water from McCallums Creek) and Tullaroop Reservoir on the Loddon River	Single treatment plant at the central holding basin (Centenary Reservoir)
Individual or small groups of towns	Amphitheatre (Avoca basin)	Reservoir on Forest Creek	None (non-potable supply)
	Avoca (Avoca basin)	Sugarloaf Reservoir in the Avoca basin	Avoca
	Beaufort and Raglan (Hopkins basin)	Musical Gully Reservoir, which captures water via diversion weirs from streams in the Hopkins basin	Supply to Raglan is untreated; supply to Beaufort is chlorinated at Musical Gully
	Blackwood and Barry's Reef (Werribee basin)	Blackwood basin, which is supplied by diversion from Kyneton Gully Creek and Long Gully Creek; supplemented by emergency groundwater bore	UV disinfection at Blackwood basin
	Clunes (Loddon basin)	Groundwater bore	Hardness removed and disinfected; treatment plant is adjacent to the bore
	Daylesford system – Daylesford, Hepburn and Hepburn Springs (Loddon basin)	Three small storages supplied from various streams	Single treatment plant for the three towns
	Dean (Loddon basin)	Groundwater bore	Chlorine disinfection
	Forest Hill system (Loddon basin) –Allendale, Newlyn, Smeaton, Kingston, Springmount, Broomfield and homes in rural areas	Three groundwater bores at Forest Hill	Hardness removed and disinfected; treatment plant is adjacent to the bores

Area	System / towns supplied	Source of supply	Treatment plant location / comment
	Landsborough and Navarre (Wimmera basin)	Landsborough Reservoir, which is supplied by diversions from several streams; supplemented by a drought-relief bore	None (non-potable supply)
	Learmonth (Loddon basin)	Groundwater bore	High-quality supply, little treatment is required
	Lexton (Loddon basin)	Lexton Reservoir, which captures water from springs in its catchment	Lexton Reservoir
	Redbank (Avoca basin)	Redbank Reservoir on the upper Avoca River, with a supplementary groundwater bore	None (non-potable supply)
	Waubra (Loddon basin)	Two groundwater bores	Chlorination at storage tanks

Table 8-35 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 8-35 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	-	13	13	0	0	13	-	100%
Avoca	-	195	78	28	88	195	-	55%
Beaufort and Raglan	-	165	95	38	32	165	-	80%
Blackwood and Barrys Reef	-	55	29	7	20	55	-	64%
Clunes	-	218	138	37	43	218	-	80%
Daylesford system	-	661	353	165	143	661	-	78%
Dean	-	15	3	2	11	15	-	29%
Forest Hill system	-	132	96	18	18	132	-	87%
Greater Ballarat	-	13,436	7,683	3,444	2,309	13,436	-	83%
Landsborough and Navarre	-	32	14	5	12	32	-	61%
Learmonth	-	48	24	17	7	48	-	86%
Lexton	-	21	14	2	6	21	-	74%
Maryborough and district	-	1,455	807	279	369	1,455	-	75%
Redbank	-	3.0	2.6	0.1	0.3	3.0	-	90%
Waubra	-	28	16	2	10	28	-	65%

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.

Table 8-36 shows Southern Rural Water's Werribee and Bacchus Marsh irrigation districts' water balances.

Table 8-36 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	2,872	2,088	61	723	2,872	10	75%
Werribee Irrigation District	100	15,675	9,314	440	5,891	15,645	130	62%

Note

(1) 'Passed to other systems' represent outfalls from the systems. BMID returns into the Lerderderg River, the WID 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 8-37 summarises Wannon Water's combined distribution systems.

Table 8-37 Wannon Water combined distribution systems

Area	System / towns supplied	Source of supply	Treatment plant location
Balmoral	Balmoral	Rocklands Reservoir	Balmoral
Dilwyn Aquifer	Portland, Heywood, Dartmoor, Port Fairy, Port Campbell, Peterborough and Timboon	Groundwater flows – numerous bores in localities serviced	Portland, Heywood, Dartmoor, Port Fairy and Port Campbell
Glenthompson	Glenthompson	Local surface water catchments into Glenthompson and Railway reservoirs, bulk supply from Grampians Wimmera Mallee Water	Glenthompson
Grampians system	Hamilton, Cavendish, Dunkeld and Tarrington	Victoria Ranges catchment (small streams and groundwater flows extracted from bores) and Rocklands Reservoir	Hamilton, Cavendish and Dunkeld
Konongwootong	Rural customers only	Local surface water catchment into Konongwootong Reservoir	None (non-potable supply)
Newer Volcanic Aquifer	Darlington, Caramut, Penshurst, Macarthur and Mortlake	Groundwater flows extracted at bores in localities serviced	Darlington, Caramut, Penshurst and Macarthur
Otway system	Warrnambool, Simpson, Cobden, Camperdown, Glenormiston, Lismore, Derrinallum, Terang, Mortlake, Purnim, Allansford and Koroit	Arkins Creek catchment, Gellibrand River catchment, groundwater flows extracted from bores near Carlisle River and at Albert Park, Warrnambool	Warrnambool, Simpson, Cobden, Camperdown, Terang and Purnim
Port Campbell Limestone Aquifer	Casterton, Coleraine, Sandford, Merino and Warrnambool	Groundwater flows extracted at Tullich borefield and at Albert Park, Warrnambool	Casterton

Table 8-38 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 8-38 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 non-residential deliveries	Rural deliveries	System losses	Passed to other systems	Total outflows		
Balmoral	-	38	12	5	16	5	-	38	-	88%
Dilwyn Aquifer	-	2,752	1,136	987	69	559	-	2,752	-	80%
Glenthompson	39	53	8	1	2	8	-	19	73	59%
Grampians system (excl. Balmoral)	1,780	1,644	749	239	69	312	38	1,407	2,017	78%
Konongwootong	-	134	-	-	31	104	-	134	-	23%
Newer Volcanic Aquifer	-	160	56	24	6	68	8	160	-	58%
Otway system	2,018	8,863	2,821	2,300	1,918	1,872	-	8,911	1,970	79%
Port Campbell Limestone Aquifer	-	758	161	78	36	87	396	758	-	89%

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 8-39 summarises Grampians Wimmera Mallee Water's combined distribution systems.

Table 8-39 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

Grampians Wimmera Mallee Water also operates 18 urban-only distribution systems, summarised in Table 8-40.

Table 8-40 Grampians Wimmera Mallee Water urban distribution systems

Area	System / towns supplied	Source of supply	Treatment plant location / comment
Ararat system	Ararat and surrounds	Mount Cole Reservoir and Lake Fyans	Ararat
Halls Gap system	Halls Gap and Pomonal	Lake Bellfield	Halls Gap
Horsham system	City of Horsham and surrounds including Haven and Natimuk	Lake Wartook and Laharum groundwater bores	Mount Zero
Quambatook	Quambatook	Normanville domestic and stock system (Loddon basin)	Chlorinator at Quambatook
Stawell system	Stawell, Great Western	Fyans Creek and Lake Fyans	Stawell and Great Western

Area	System / towns supplied	Source of supply	Treatment plant location / comment
Willaura system	Willaura, Lake Bolac, Moyston and Wickliffe	Mt William, Stony and Masons creeks; groundwater bores (unincorporated area)	Willaura serves Willaura and Lake Bolac; untreated at Moyston and Wickliffe
Towns supplied from groundwater	Apsley	West Wimmera	Untreated
	Cowangie	Murrayville	Untreated
	Goroke	West Wimmera	Untreated
	Edenhope	West Wimmera	Edenhope
	Harrow	West Wimmera	Untreated
	Kaniva	West Wimmera	Untreated
	Kiata	West Wimmera	Untreated
	Lillimur	West Wimmera	Untreated
	Miram	Murrayville	Untreated
	Murrayville	West Wimmera	Untreated
	Nhill	West Wimmera	Untreated
	Serviceton	Glenelg Catchment Unit	Untreated
	Streatham and Westmere	West Wimmera	Untreated

Table 8-41 shows Grampians Wimmera Mallee Water's combined distribution systems' water balances.

Table 8-41 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	180	2,993	438	217	1,430	908	2,993	180	70%
Wimmera Mallee Pipeline Supply System 1	-	1,564	487	254	407	416	1,564	-	73%
Wimmera Mallee Pipeline Supply System 2	-	2,470	554	137	1,122	658	2,470	-	73%
Wimmera Mallee Pipeline Supply System 3	-	1,820	103	22	1,212	485	1,820	-	73%
Wimmera Mallee Pipeline Supply System 4	-	2,039	562	250	693	533	2,039	-	74%
Wimmera Mallee Pipeline Supply System 5	-	269	37	18	100	115	269	-	57%
Wimmera Mallee Pipeline Supply System 6	31	509	1	0	389	30	420	120	93%
Wimmera Mallee Pipeline Supply System 7	-	254	76	102	8	68	254	-	73%

Table 8-42 shows Grampians Wimmera Mallee Water's urban distribution systems' water balances.

Table 8-42 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	262	1,349	674	550	139	0	1,363	249	90%
Buangor	29	12	11	1	3	0	15	26	79%
East Grampians system (Willuara)	94	262	102	80	41	39	262	94	84%
Elmhurst (1)	11	49	13	3	14	0	31	30	n/a
Horsham system	225	2,525	1,693	354	478	0	2,525	225	81%
Quambatook	100	97	31	16	51	0	97	100	48%
Stawell system	390	1,460	573	676	197	0	1,445	405	86%
Groundwater systems									
Apsley (2)	-	10	16	6	(12)	0	9	-	n/a

Cowangie	-	9	1	1	7	0	9	-	21%
Edenhope	-	133	71	30	33	0	133	-	75%
Goroke	-	45	27	6	12	0	45	-	73%
Harrow	-	33	17	3	12	0	33	-	62%
Kaniva	-	173	111	51	11	0	173	-	93%
Kiata	-	5	3	0	3	0	5	-	54%
Lillimur	-	7	5	0	1	0	7	-	82%
Miram	-	1	1	0	0	0	1	-	88%
Murrayville	-	100	55	33	12	0	100	-	88%
Serviceton	-	10	4	1	5	0	10	-	47%
Streatham & Westmere	3	25	6	5	16	0	27	1	41%

Notes

(1) 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.

(2) GWMWater 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.

Abbreviations

AWRC	Australian Water Resources Council
CEWH	Commonwealth Environmental Water Holder
CEWO	Commonwealth Environmental Water Office
CW	Coliban Water
CMA	Catchment management authority
DELWP	Department of Environment, Land, Water and Planning (Victorian Government)
ENSO	El Niño – Southern Oscillation
EPA	Environment Protection Authority Victoria
ESC	Essential Services Commission
FFG	Victorian *Flora and Fauna Guarantee Act 1988*
GIS	Global information system
GL	Gigalitre (1,000,000,000 litres)
GMA	Groundwater management area
GMU	Groundwater management unit
GMW	Goulburn Murray Water
GVW	Goulburn Valley Water
IOD	Indian Ocean Dipole
MDBA	Murray–Darling Basin Authority
ML	Megalitre (1,000,000 litres)
NVIRP	Northern Victoria Irrigation Renewal Project
PCV	Permissible consumptive volume
PWSR	Permanent water-saving rules
REALM	REsource ALlocation Model
RWC	Rural water corporation
SFMP	Streamflow management plan
SIR	Shepparton Irrigation Region
SOBN	State Observation Bore Network
UTQA	Upper Tertiary Quaternary Aquifer
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.

Backwash (water): Water pumped backward through filters at a wastewater treatment plant as part of their maintenance.

Basin: The area of land into which a river and its tributaries drain. In the Victorian Water Accounts, basins are consistent with those defined by the AWRC. The exception is the Murray basin which, for the purposes of the accounts, includes the Upper Murray basin as defined by the AWRC and areas in Victoria supplied from the Murray River downstream of Lake Hume. See also ‘River basin’, a term with the same meaning used occasionally in the accounts to make the narrative clearer.

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. The entitlement may also specify the rate at which the water 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 volume of water that can be allocated for consumptive use from a basin within a given timeframe. ‘Above cap’ water is all the water above this volume.

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 authorities (CMAs): Statutory bodies 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; regional and catchment planning and coordination; and waterway, floodplain, salinity and water quality management.

Declared systems: 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 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 located beneath the earth’s surface in pores and crevices of rocks and soil. Areas with such reserves vary in size and volume throughout Victoria, and they are known as aquifers.

Groundwater management unit (GMU): Groundwater in Victoria is managed through groundwater management units (GMUs). A GMU may be classified as either a groundwater management area (GMA) or a water supply protection area (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 Program: 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 1997 to 2009.

Murray–Darling Cap: The climatically adjusted limit on surface water diversions in the Murray–Darling Basin, introduced by the Murray—Darling Basin Ministerial Council in June 1995.

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.

Outside management 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.

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 the Victorian Department of Environment, Land, Water and Planning 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.

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* (NSW). 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.

Supernatant (water): The water remaining after waste matter has been settled out of (and otherwise removed) from water being treated at a wastewater management facility.

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.

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 previously 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 estimates vary considerably across Victoria depending on a range of factors, including water availability. Averaged across Victoria as a whole, evapotranspiration in 2016–17 was estimated to be 582 mm, which is about 7% more than the long-term average from 1961 to 1990.

Modelled estimates of basin evapotranspiration are shown in Figure A-1. Evapotranspiration is shown in terms of millimetres per unit area, to allow for direct comparison between basins of different sizes.

The figure shows that for all basins in the north-west, north-east and south-west of the state, the annual estimated evapotranspiration was higher than under average conditions. Conversely, for the south-east, all but three basins — the Maribyrnong, Yarra and Bunyip basins — experienced lower evapotranspiration than average. The difference between the evapotranspiration volumes for 2016–17 and the long-term average varied between basins. The difference was greatest in the north-west, where evapotranspiration was up to 20% higher than the long-term average: in the far south-east, evapotranspiration was similar to the long-term average. These differences broadly reflect rainfall over the year, with below-average rainfall in the south-east; but in the south-east the difference between the annual evapotranspiration and average conditions was smaller than the corresponding percentage difference for rainfall.

Figure A-1 Evapotranspiration per unit area (mm), 2016–17 estimate and long-term average (1961–90)

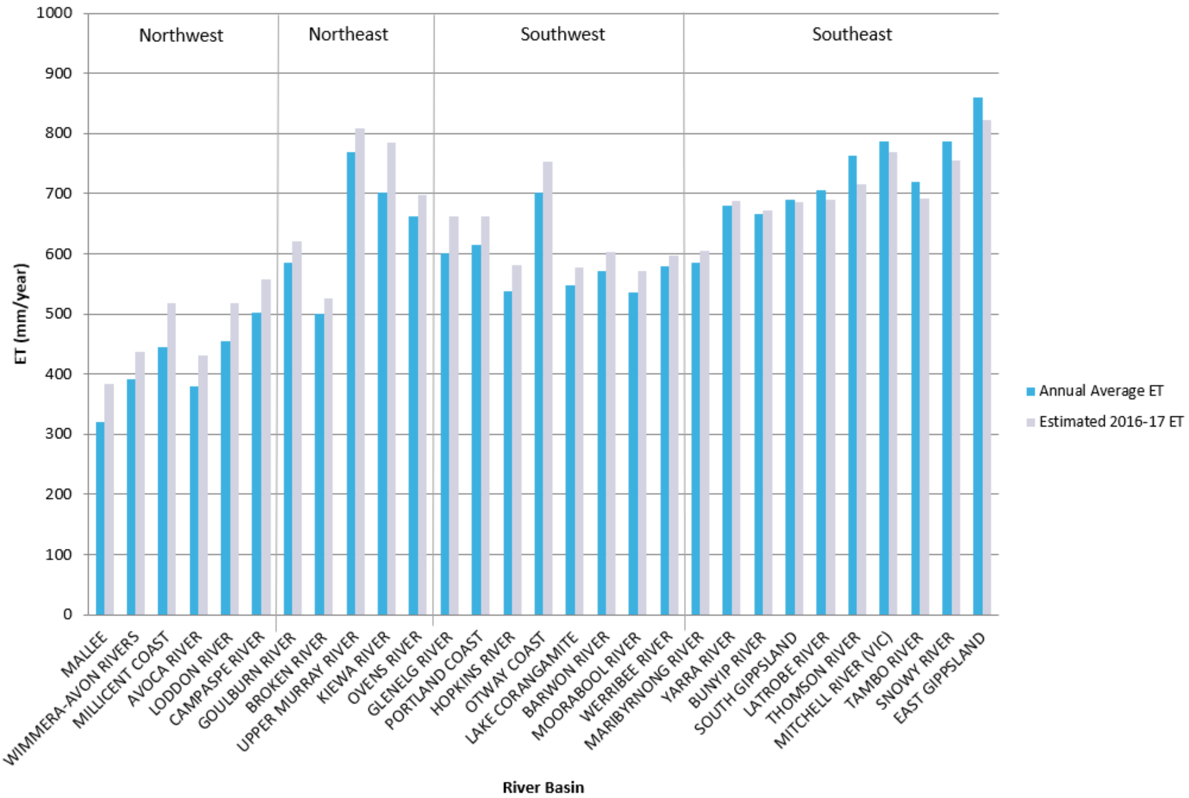
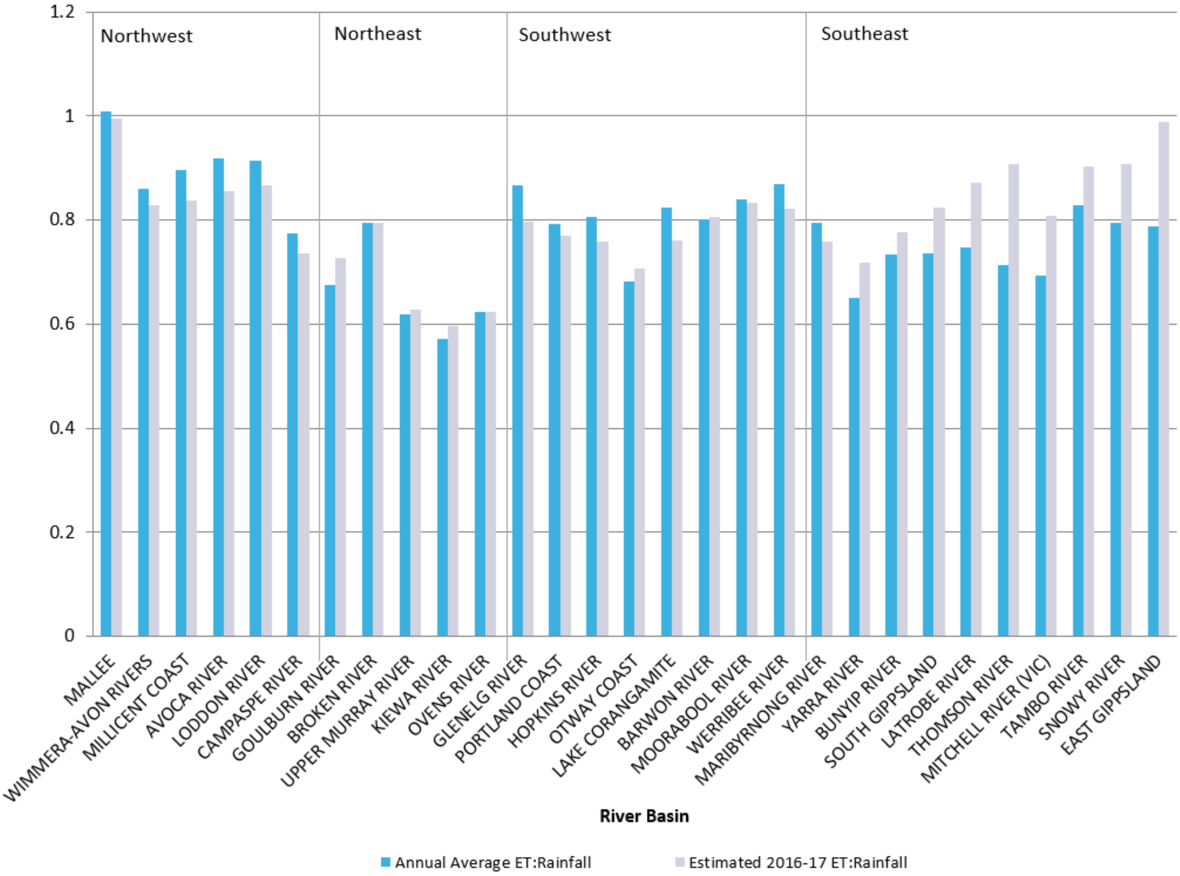


Figure A-2 shows estimated evapotranspiration as a proportion of rainfall in Victoria's basins. In 2016–17, the proportion of evapotranspiration to rainfall was generally lower than the long-term average in most basins, except for some areas in the north-east and south-east of the state. This is consistent with the above-average rainfalls observed for all parts of the state except for the east, because the proportion of evapotranspiration to rainfall generally decreases as rainfall increases.

Figure A-2 Evapotranspiration as a percentage of rainfall, 2016–17 estimate and long-term average (1961–90)



North-east Victoria (Goulburn to Upper Murray basins)

Above-average rainfall over north-east Victoria in 2016–17 resulted in estimated evapotranspiration that was above-average for the north-eastern basins. Estimated evapotranspiration ranged from 526 mm in the Broken basin to 809 mm in the Upper Murray basin, and comparisons with the long-term average ranged from 5% above average in the Ovens basin to 12% above average in the Kiewa basin (Figure A-1).

In 2016–17, estimated evapotranspiration as a proportion of rainfall in the north-eastern basins was higher than the long-term average. The Broken basin had the north-east region's highest estimated evapotranspiration as a proportion of rainfall (79%, the same as the long-term average); the lowest was in the Kiewa basin (60%, 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-east Victoria in 2016–17 resulted in estimated evapotranspiration that was below-average for the south-eastern basins. Estimated evapotranspiration ranged from 604 mm in the Maribyrnong basin to 821 mm in the East Gippsland basin, and comparisons with the long-term average ranged from 6% below average in the Thomson basin to 3% above average in the Maribyrnong basin (Figure A-1).

In 2016–17, estimated evapotranspiration as a proportion of rainfall in the south-eastern basins was higher than the long-term average. East Gippsland had the south-east region's highest estimated evapotranspiration as a proportion of rainfall (99%, compared to the long-term average of 79%); 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)

Slightly above-average rainfall over south-west Victoria in 2016–17 resulted in estimated evapotranspiration that was above-average for the south-western basins. Estimated evapotranspiration ranged from 572 mm in the Moorabool basin to 754 mm in the Hopkins basin, and comparisons with the long-term average ranged from 3% above average in the Werribee basin to 10% above average in the Glenelg basin (Figure A-1).

In 2016–17, estimated evapotranspiration as a proportion of rainfall in the south-western basins was broadly lower than the long-term average. The Moorabool basin had the south-west region's highest estimated evapotranspiration as a proportion of rainfall (83%, the same as the long-term average); the lowest was in the Otway Coast basin (70%, compared to the long-term average of 68%) (Figure A-2).

North-west Victoria (Mallee to Campaspe basins)

Notably above-average rainfall over north-western Victoria in 2016–17 resulted in estimated evapotranspiration that was above-average for the north-western basins. Estimated evapotranspiration ranged from 383 mm in the Mallee basin to 557 mm in the Campaspe basin, and comparisons with the long-term average ranged from 11% above average in the Campaspe basin to 20% above average in the Mallee basin (Figure A-1).

In 2016–17, estimated evapotranspiration as a proportion of rainfall in the north-western basins was lower than the long-term average. The Mallee basin had the north-west region's highest estimated evapotranspiration as a proportion of rainfall (100%, compared to the long-term average of 101%); the lowest was in the Campaspe basin (74%, compared to the long-term average of 77%) (Figure A-2).

Key assumptions and data limitations

The estimates of evapotranspiration shown 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. The major assumptions and limitations of the method used to derive the estimates of evapotranspiration are:

- not accounting for water applied by irrigation
- not allowing for changes in water storage (that is, rises and falls in the water table and soil moisture) or lateral flow
- aggregation of 2016 land-use information into a series of 10 representative land-use classes, to facilitate water-balance modelling
- 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 in 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 2016	% full at 30 June 2017
Murray	Kangaroo Lake	Off-stream	39,200	80%	80%
	Kow Swamp	Off-stream	51,710	78%	69%
	Lake Boga	Off-stream	37,000	49%	55%
	Lake Charm	Off-stream	22,000	85%	138%
	Lake Cullulleraine	Off-stream	5,270	84%	84%
	Lake Dartmouth (Vic. share)	On-stream	1,928,116	54%	88%
	Lake Hume (Vic. share)	On-stream	1,502,579	39%	82%
	Lake Victoria (Vic. share)	On-stream	385,000	54%	53%
	Menindee Lakes (Vic. share)	On-stream	865,500	0%	31%
Kiewa	Clover Pondage	Off-stream	255	24%	46%
	Lake Guy	On-stream	1,416	25%	40%
	Pretty Valley basin	Off-stream	355	100%	100%
	Rocky Valley	On-stream	28,294	64%	46%
Ovens	Lake Buffalo	On-stream	23,340	63%	56%
	Lake William Hovell	On-stream	13,690	101%	91%
Broken	Lake Nillahcootie	On-stream	40,400	29%	77%
	Loombah-McCall Say	On-stream	1,747	100%	100%
Goulburn	Goulburn Weir	On-stream	25,500	79%	95%
	Greens Lake	Off-stream	32,500	55%	70%
	Lake Eildon	On-stream	3,334,158	36%	63%
	Sunday Creek Reservoir	On-stream	1,650	39%	59%
	Waranga basin	Off-stream	432,360	52%	53%
Campaspe	Campaspe Weir	On-stream	2,624	101%	103%
	Lake Eppalock	On-stream	304,651	22%	89%
	Lauriston Reservoir	On-stream	19,790	66%	87%
	Malmsbury Reservoir	On-stream	12,034	23%	16%
	Upper Coliban Reservoir	On-stream	37,770	39%	93%
Loddon	Cairn Curran Reservoir	On-stream	147,130	12%	75%
	Evansford Reservoir	Off-stream	1,346	68%	74%
	Hepburn Lagoon	On-stream	2,457	18%	65%
	Laanecoorie Reservoir	On-stream	8,000	21%	40%
	Newlyn Reservoir	On-stream	3,012	17%	68%
	Sandhurst Reservoir	Off-stream	2,590	100%	53%
	Spring Gully Reservoir	Off-stream	1,680	76%	62%
	Tullaroop Reservoir	On-stream	72,950	21%	73%
East Gippsland	None	-	-	-	-
Snowy	None	-	-	-	-
Tambo	None	-	-	-	-
Mitchell	None	-	-	-	-
Thomson	Lake Glenmaggie	On-stream	177,640	46%	26%
	Thomson Reservoir	On-stream	1,068,000	56%	60%
Latrobe	Blue Rock Lake	On-stream	198,280	86%	90%
	Lake Narracan	On-stream	7,230	61%	16%
	Moondarra Reservoir	On-stream	30,458	85%	64%
South Gippsland	Candowie Reservoir	On-stream	4,463	50%	54%
	Hyland Reservoir	On-stream	671	59%	49%
	Lance Creek Reservoir	On-stream	4,200	79%	74%
	Western Reservoir	On-stream	1,137	42%	38%
Bunyip	Tarago Reservoir	On-stream	37,580	91%	88%
Yarra	Cardinia Reservoir	Off-stream	286,911	63%	66%
	Greenvale Reservoir	Off-stream	26,839	80%	84%
	Maroondah Reservoir	On-stream	22,179	49%	39%
	O'Shannassy Reservoir	On-stream	3,123	74%	81%
	Silvan Reservoir	Off-stream	40,445	89%	87%

Basin	Reservoir	On-stream / off-stream	Storage capacity (ML)	% full at 1 July 2016	% full at 30 June 2017
	Sugarloaf Reservoir	Off-stream	96,253	68%	70%
	Upper Yarra Reservoir	On-stream	200,579	51%	48%
	Yan Yean Reservoir	On-stream	30,266	80%	87%
Maribyrnong	Rosslynne Reservoir	On-stream	25,368	15%	38%
Werribee	Djerriwarrh Reservoir	On-stream	1,014	39%	95%
	Melton Reservoir	On-stream	14,364	7%	51%
	Merrimu Reservoir (total)	On-stream	32,516	10%	50%
	Pykes Creek Reservoir	On-stream	22,119	27%	81%
Moorabool	Bostock Reservoir	On-stream	7,455	1%	58%
	Korweinguboora Reservoir (1)	On-stream	2,327	16%	44%
	Lal Lal Reservoir	On-stream	59,549	36%	53%
	Moorabool Reservoir	On-stream	6,192	12%	70%
	Upper Stony Creek Reservoir	Off-stream	9,494	41%	57%
	Wilsons Reservoir	On-stream	1,010	2%	9%
Barwon	Gong Gong Reservoir	On-stream	1,902	13%	80%
	West Barwon Reservoir	On-stream	22,064	20%	40%
	White Swan Reservoir	On-stream	14,107	59%	87%
	Wurdee Boluc Reservoir	Off-stream	40,432	34%	57%
Corangamite	None	-	-	-	-
Otway Coast	West Gellibrand Reservoir	On-stream	1,856	64%	71%
Hopkins	None	-	-	-	-
Portland Coast	None	-	-	-	-
Glenelg	Hamilton system reservoirs	On-stream	2,654	67%	75%
	Konongwootong Reservoir	On-stream	1,920	74%	95%
	Moora Moora Reservoir	On-stream	6,300	14%	60%
	Rocklands Reservoir	On-stream	295,955	15%	43%
Millicent Coast	None	-	-	-	-
Wimmera	Dock Lake (2)	On-stream	4,420	0%	0%
	Fyans Lake	On-stream	18,460	53%	75%
	Green Lake	On-stream	5,350	9%	64%
	Lake Bellfield	On-stream	78,560	56%	81%
	Lake Lonsdale	On-stream	53,300	0%	62%
	Pine Lake (2)	On-stream	62,000	0%	0%
	Taylors Lake	On-stream	27,060	46%	76%
	Toolondo Reservoir	On-stream	50,533	7%	27%
	Wartook Reservoir	On-stream	29,300	53%	73%
Mallee	None	-	-	-	-
Avoca	None	-	-	-	-
Total			**12,521,909**		

Notes

(1) Korweinguboora Reservoir was resurveyed during 2016–17 and the total capacity increased from 2,091 to 2,327.

(2) 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

Groundwater management unit	Permissible consumptive volume	Allocation limit at 30/06/17 (ML)	Licenses				Domestic and stock		Total use (licensed + domestic and stock)
			Licensed entitlements (ML)	No. of licences	No. of metered bores	Metered volume (ML)	No. of domestic and stock bores (1)	Estimated use (ML) (2)	
Goulburn–Murray Water									
Water supply protection areas									
Katunga (3)	60,577	42,232	60,219	250	187	22,528	751	1,502	24,030
Loddon Highlands (4)	20,697	19,769	20,507	178	236	5,435	589	1,178	6,613
Lower Campaspe Valley	55,875	55,662	55,860	8	151	24,383	534	1,068	25,451
Upper Ovens (5)	n/a	3,650	3,650	102	83	970	256	512	1,482
Groundwater management areas									
Barnawartha	2,100	2,100	375	4	6	6	25	50	56
Broken	3,732	3,732	2,887	65	76	388	414	828	1,216
Central Victorian Mineral Springs	6,024	6,024	5,014	143	124	882	1,400	2,800	3,682
Eildon	1,496	1,496	587	24	76	180	281	562	742
Kiewa	3,852	3,852	3,122	105	77	405	275	550	955
Lower Ovens	25,200	25,200	19,905	19	198	5,839	1,507	3,014	8,853
Mid-Goulburn	12,470	12,470	12,470	65	59	1,786	124	248	2,034
Mid-Loddon	34,037	34,037	33,927	103	127	12,285	331	662	12,947
Shepparton Irrigation (6) (7)	n/a	n/a	191,130	1,021	0	54,220	1,305	2,610	56,830
Strathbogie	1,660	1,660	1,422	57	30	468	277	554	1,022
Upper Goulburn	8,568	8,568	6,026	113	75	1,034	542	1,084	2,118
Upper Murray	7,674	7,674	3,403	72	55	440	187	374	814
Outside management units									
Goulburn–Murray unincorporated areas	n/a	n/a	14,720	133	17	2,575	754	1,508	4,083
Grampians Wimmera Mallee Water									
Water supply protection areas									
Murrayville	10,883	10,883	9,634	33	31	5,805	185	370	6,175
Groundwater management areas									
West Wimmera (8) (9)	55,659	55,659	53,372	171	197	24,428	638	1,276	25,704
Outside management units									
Grampians Wimmera Mallee Water	n/a	n/a	13,180	52	19	1,062	321	642	1,706
Southern Rural Water									
Water supply protection areas									
Condah	7,475	7,475	7,470	33	43	2,666	321	482	3,148
Deutgam (10)	5,100	2,550	5,082	148	172	527	37	56	583
Glenelg	33,262	33,262	15,756	38	55	3,072	1,065	1,598	4,670
Koo-Wee-Rup	12,915	12,915	12,577	351	224	3,503	954	1,431	4,934
Sale	21,238	21,238	21,218	112	119	11,982	422	633	12,615
Warrion	14,086	14,086	14,079	132	131	3,702	244	366	4,068
Yarram	25,690	25,690	25,689	86	89	12,246	271	407	12,653
Groundwater management areas									
Bungaree (11)	5,334	5,334	5,293	99	146	2,291	166	249	2,540
Cardigan	3,967	3,967	3,874	20	23	751	83	125	876
Colongulac	4,695	4,695	4,406	67	38	1,244	97	146	1,390

Groundwater management unit	Permissible consumptive volume	Allocation limit at 30/06/17 (ML)	Licenses				Domestic and stock		Total use (licensed + domestic and stock)
			Licensed entitlements (ML)	No. of licences	No. of metered bores	Metered volume (ML)	No. of domestic and stock bores (1)	Estimated use (ML) (2)	
Corinella	2,550	2,550	662	13	9	66	57	86	152
Cut Paw Paw	3,650	3,650	514	4	3	26	4	6	32
Denison (12)	18,502	18,502	18,499	120	122	6,882	201	302	7,184
Frankston	3,200	3,200	2,207	28	21	148	94	141	289
Gellibrand (13)	n/a	0	0	0	0	0	0	0	0
Gerangamete (14)	20,000	20,000	20,000	1	6	1,546	5	8	1,554
Giffard	5,689	5,689	5,689	18	18	1,856	93	140	1,996
Glenormiston	2,698	2,698	2,636	45	28	1,078	68	102	1,180
Jan Juc (15)	39,250	39,250	14,250	2	8	223	3	5	228
Lancefield	1,485	1,485	1,378	15	19	193	52	78	271
Leongatha	6,500	6,500	1,803	33	12	115	72	108	223
Merrimu	451	451	0	0	0	0	12	18	18
Moe	8,200	8,200	3,889	97	34	915	112	168	1,083
Moorabbin	2,700	2,700	2,581	55	79	925	197	296	1,221
Nepean (8)	6,110	6,110	6,110	76	78	2,304	1,820	1,820	4,124
Newlingrook	1,977	1,977	1,958	6	6	89	2	3	92
Orbost	1,217	1,217	1,217	4	5	104	3	5	109
Paaratte (16)	4,606	4,606	3,212	6	1	314	2	3	317
Portland	7,795	7,795	7,794	8	7	2,389	1	2	2,391
Rosedale (8) (16)	22,372	22,372	22,322	70	52	7,573	86	129	7,702
South West Limestone (17)	n/a	85,000	81,253	830	643	25,086	5,370	8,056	33,142
Stratford (8) (16)	27,645	27,645	36,953	10	6	25,102	4	8	25,110
Tarwin	1,300	1,300	38	3	1	5	493	740	745
Wa De Lock (8) (12)	30,795	30,795	29,140	251	180	6,984	416	624	7,608
Wandin Yallock (11)	3,008	3,008	2,994	193	206	564	50	75	639
Wy Yung (8)	7,463	7,463	7,462	59	74	560	33	50	610
Outside management units									
Southern Rural Water	n/a	n/a	70,160	1,334	794	12,062	5,068	7,602	19,664
Total 2016–17	**673,429**	**740,043**	**971,575**	**7,085**	**5,276**	**304,212**	**28,674**	**47,460**	**351,672**
Total 2015–16	759,641	738,186	968,647	7,587	5,951	409,025	29,253	48,349	457,374

Notes

(1) The number of 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.

(4) Extractions from Newlyn trading zone in the Loddon Highlands WSPA were restricted to 75% allocation. The Ascot and Blampied zones were also restricted to 75% until November 2016, when restrictions were lifted and entitlement holders could access 100% of the allocation limit.

(5) The revocation of the Upper Ovens WSPA PCV was approved on 3 March 2013 and published in the *Victorian Government Gazette* on 7 March 2013.

(6) There is no permissible consumptive volume for the Shepparton Irrigation Region GMA.

(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 using the approach provided in the management plan.

(8) 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.

(9) Extractions from Neuarpur subzone 1 (a trading zone in the West Wimmera GMA) were restricted to 80% allocation.

(10) Extractions from Deutgam WSPA were restricted to 50% allocation.

(11) Abolition of Wandin Yallock WSPA and Bungaree WSPA was approved on 30 November 2016 and published in the *Victorian Government Gazette* on 8 December 2016.

(12) The volume of use in Denison GMA and Wa De Lock GMA includes metered extractions for salinity control (Denison GMA 691 ML and Wa De Lock GMA 749 ML).

(13) All existing domestic and stock bores in the Gellibrand GMA are more than 30 years old and considered to be non-operational. Therefore, domestic and stock bores and use are considered to be zero for 2016–17.
(14) 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.
(15) 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 39,250 ML includes 4,250 ML and the five-year bulk entitlement of 35,000 ML.
(16) The entitlement volume reported in Rosedale and Stratford GMAs includes licence volume for the Latrobe Valley coal mines (Rosedale GMA 9,304 ML and Stratford GMA 36,207 ML).
(17) The South West Limestone GMA PCV 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.

Appendix D: Bulk entitlement holders

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
	Bulk Entitlement (Goulburn System – City West Water) Order 2012	City West Water
	Environmental Entitlement (Goulburn System – NVIRP Stage 1) 2012	Victorian Environmental Water Holder

Basin	Entitlements	Holder
Goulburn	*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
	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

Basin	Entitlements	Holder
Latrobe	*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
Barwon	*Barwon River Environmental Entitlement 2011*	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

Basin	Entitlements	Holder
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