

Resource Review



Water resources in the Gippsland Region

To determine how to balance future water availability we need to understand how water is currently sourced, allocated and used in the Gippsland Region, including how this impacts on the community and economy.

The majority of water used in the Gippsland Region for towns, industry and agriculture is sourced from rivers and streams, with the remainder sourced from groundwater and a very small proportion drawn from alternative sources (stormwater and recycled wastewater). Refer to Figure 2.1.

Measuring water volumes

We measure water in terms of litres. Larger volumes of water are described in this Discussion Paper as megalitres (ML), which means one million litres, or gigalitres (GL), which is a thousand million litres.

Volumes are often presented in this document as 'annual averages'. The annual averages presented have in most cases been calculated using the past 50 years of recorded or modelled data.

Water availability in the Gippsland Region

Water resources are distributed reasonably evenly across the Gippsland Region. Water availability does not necessarily align with water demand, with a far higher demand for water in west, central and south Gippsland than in east Gippsland.

Surface Water

Surface water is created by the rain that falls on river catchments and flows into rivers, reservoirs and receiving estuaries.

The Gippsland Region is comprised of eight major river systems - the Latrobe, Thomson/Macalister, Mitchell, Snowy, South Gippsland, Tambo, Avon and East Gippsland basins. The Latrobe, Thomson/Macalister, Mitchell and Snowy are the larger river basins, while the East Gippsland and South Gippsland basins consist of numerous small rivers with outlets to the sea (see Figures 2.2 and 2.3). Approximately 40 per cent of the Snowy River catchment lies within Victoria, with the remainder in New South Wales.

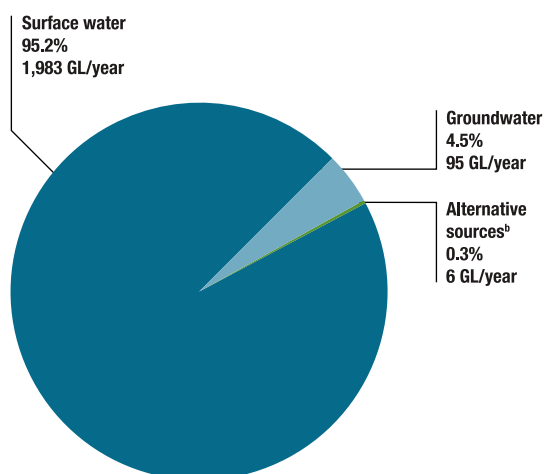
Historical records show there has been an average of 6,919 GL a year of surface water in the Gippsland Region (see Table 2.1, Column A). This total resource can be separated into water for consumptive use, water for the environment and unallocated water.

Approximately 1,993 GL of water is allocated for use each year on average. Of this water 1,140 GL is diverted west by the Snowy Scheme to the Murray and Murrumbidgee systems.²

Figure 2.4 presents the average annual surface water availability, based on historical records.

Table 2.1 shows a breakdown of the available surface water in Gippsland catchments and how this water is allocated.

FIGURE 2.1 - Proportion of water sources available for use on average in the Gippsland Region^a



Notes:

a Data based on long-term modelling.

b Includes Gippsland Water Factory (3 GL per year).

FIGURE 2.2 - Map of main rivers, streams, river basins and waterways in the Gippsland Region

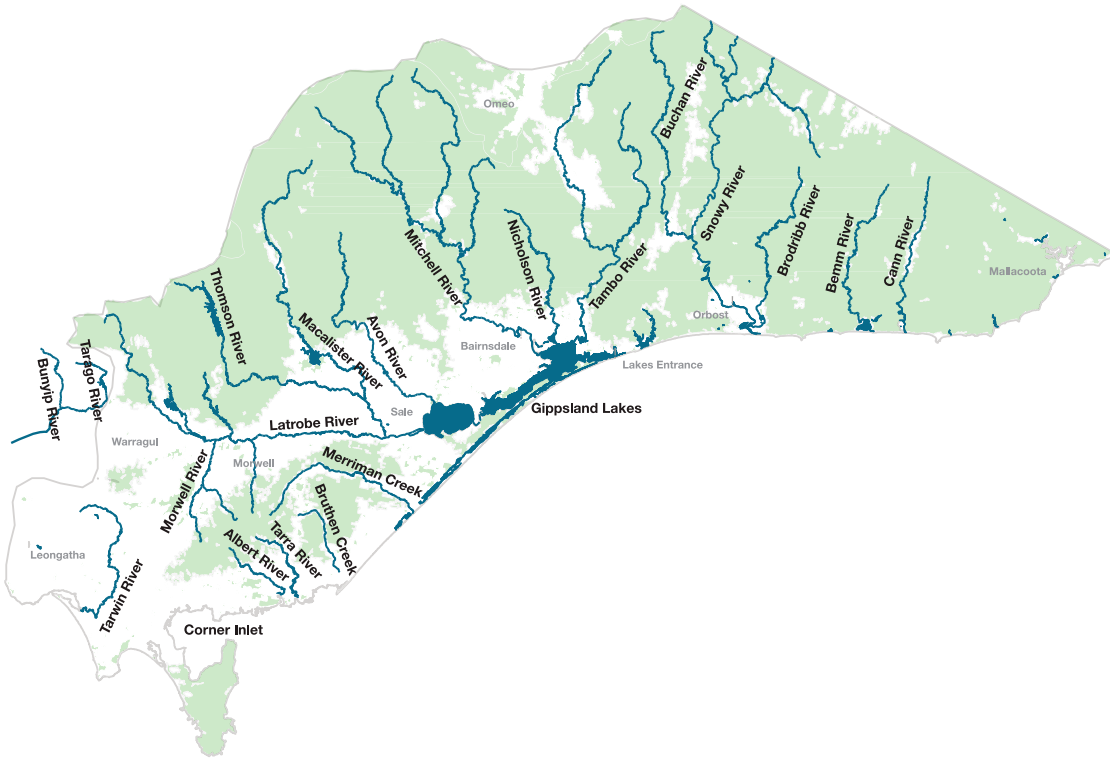
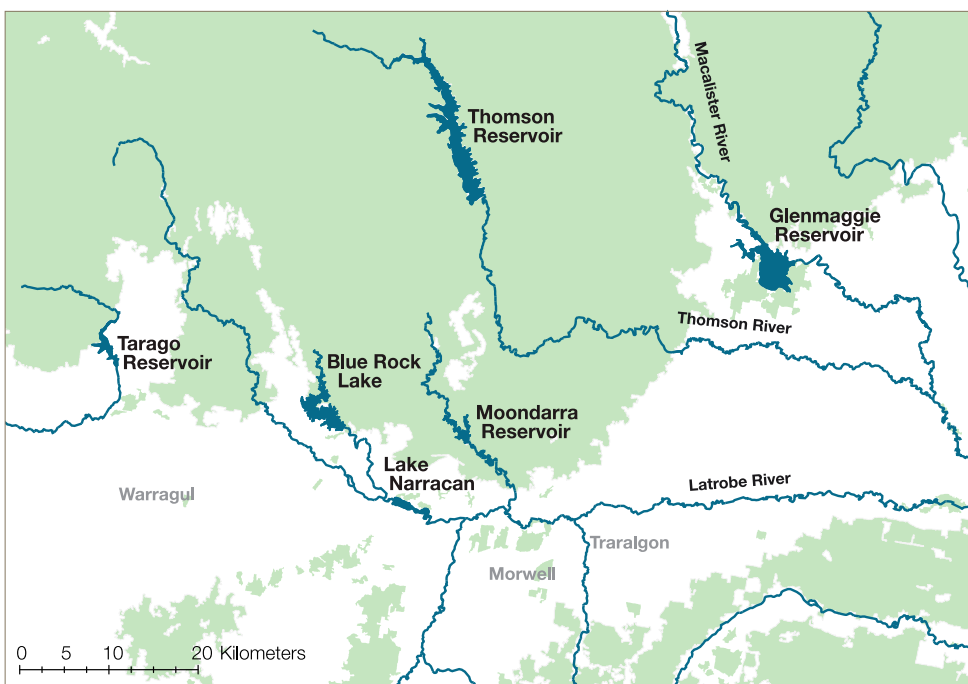


FIGURE 2.3 - Map of major storages in the Gippsland Region



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FIGURE 2.4 - Average annual volume of surface water available in the Gippsland Region

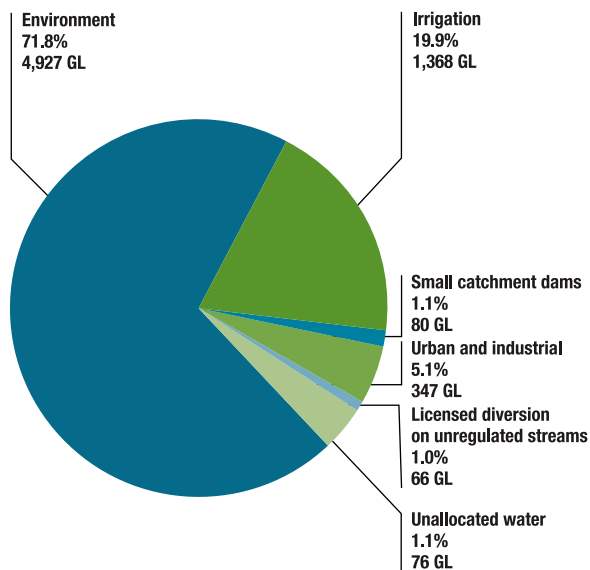


Table 2.1 and Figure 2.4 are average annual volumes, and therefore do not give a picture of the water available during dry years or dry months.

The volumes in Table 2.1 are extracted from a variety of sources including REALM models, *Victorian Water Accounts*, gauging station data and other sources. The figures should be interpreted as indicative estimates and are intended to represent annual averages over the long-term (eg. a period of approximately 50 years). For more details on specific sources, refer to the notes under Table 2.1. The amount of water taken out for consumptive use can be further categorised into:

- entitlements for urban and industrial users including the power generation companies (Column B)
- entitlements for rural users in regulated systems (Column C)
- licensed diversions on unregulated systems (Column D)
- an estimate of the amount of water captured in small catchment dams (Column E).

The estimates in Table 2.1 are long-term averages - actual volumes will vary from year to year with climatic variability. The estimates of use under entitlements are based on the maximum that could be taken, rather than historical levels of use.

Water is also lost from the system or unaccounted for. Some of this water is distribution losses included in the water that can be taken under entitlements (Columns B and C). Inefficient distribution systems result in water losses through leakage, seepage and evaporation.

Flow in rivers varies significantly from year to year and month to month, depending on rainfall, whether the catchment is dry or saturated, temperature and how much water is diverted for consumptive use. The most commonly recognised variability is the seasons. In winter and spring we expect relatively higher rainfall and lower rainfall in summer. Autumn rain is also important to wet the catchment, so subsequent rain events produce reasonable rates of run-off into rivers and storages. Variability also occurs over the longer term period. Over the last 12 years Victoria has experienced a prolonged period of below average annual rainfall resulting in lower river flows. Figure 2.5 illustrates this using the Mitchell River as an example. Figure 2.6 shows that the impact of below average rainfall varies considerably throughout the year. For example, flows in the month of May have been significantly lower when compared to the longer-term average.

This variability significantly limits the amount of water that can be reliably harvested for consumptive purposes. For example, in the summer of 2006/07 the flow in the Mitchell River averaged 75 ML per day at Glenaladale and fell as low as 10 ML per day. In accordance with flow sharing rules, extraction for urban use over the summer period was approximately 680 ML, which equated to about 10 per cent of the flow that reached Glenaladale.



Irrigation in the Lindenow Flats (Photographer: DSE)

TABLE 2.1 - Availability of surface water in the Gippsland Region (ML/yr)

Basin	Total Resource	Water that could be taken under entitlements (B – E)					Average environmental flows		
	A	B	C	D	E	F	G	H	I
	Average annual streamflows (ML/year)	Bulk entitlements		Licensed diversions on unregulated streams (ML/year)	Small catchment dams (ML/year)	Unallocated Water (ML/year)	Environmental Entitlement (ML/year)	Total (ML/year)	Average flows at basin outlets (ML/year)
		Urban & Industrial (ML/year)	Irrigation (ML/year)						
East Gippsland ^a	714,000 ^{bcd}	600 ^e	-	600 ^f	1,600 ^b	16,200 ^b	-	19,000	695,000
Snowy ^g	2,162,100 ^d	2,000 ^e	1,140,000 ^h	3,100 ^f	2,000 ^b	-	32,795	1,179,895	1,015,600 ^d
Tambo & Nicholson	297,800 ^{cd}	3,300 ^e	-	3,200 ^f	4,100 ^b	- ⁱ	-	10,600	285,900
Mitchell	884,500 ^c	5,900 ^c	-	18,200 ^f	6,100 ^c	- ⁱ	-	30,200	853,900
Avon	239,600 ^c	40 ^c	-	8,300 ^c	7,200 ^c	- ⁱ	-	15,540	223,900
Thomson	365,760 ^c	168,130 ^{ej}	23,820 ^c	-	920 ^b	-	10,000	202,870	138,440
Macalister	496,400 ^c	1,510 ^c	199,860 ^c	5,680	1,670 ^b	-	-	208,710	280,410
Latrobe	847,400 ^c	156,700 ^{ek}	4,600 ^c	16,300 ^c	24,200 ^c	26,100 ^{dl}	-	227,900	610,500
South Gippsland ^a	911,500 ^{bcd}	9,550 ^{ce}	-	10,500 ^f	32,200 ^b	32,100 ^b	-	84,350	834,500
Total	6,919,100	347,730	1,368,280	65,900	79,990	76,400	42,795	1,983,075	4,938,150

Notes:

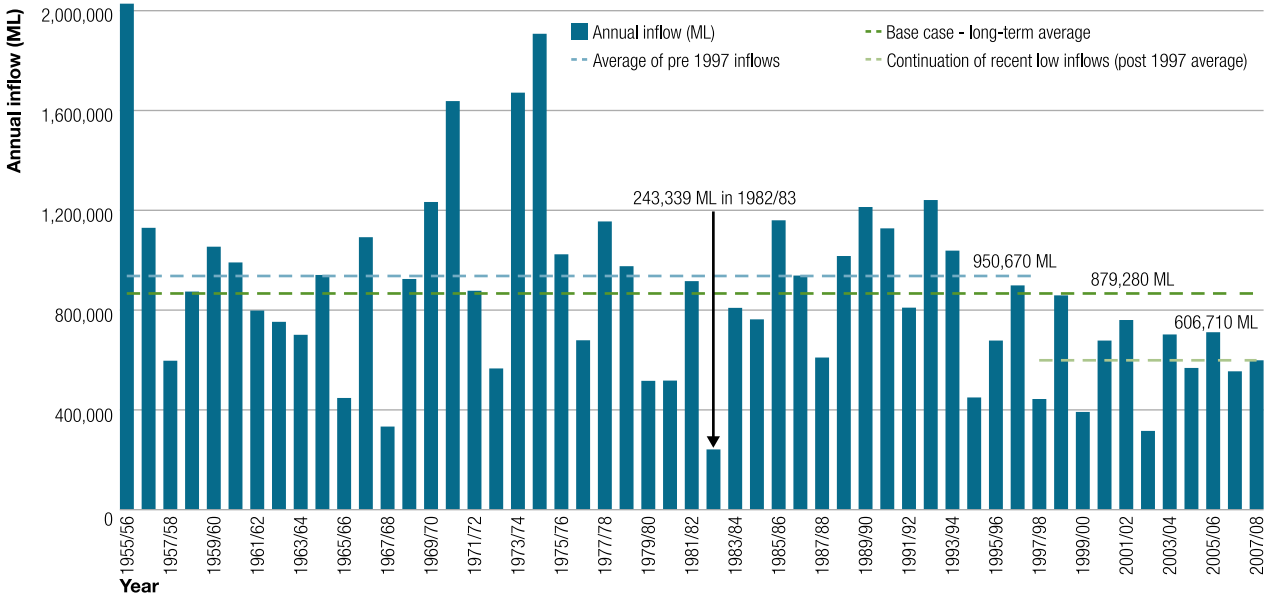
- a East and South Gippsland figures include all small coastal systems, excluding those that fall within Wilsons Promontory National Park.
b Data sourced (fully or in part) from Sustainable Diversion Limits project data.
c Calculated from modelling (REALM).
d Calculated from gauging station data.
e Assumed 0.9 x entitlement volume.
f Assumed 0.8 x licensed volume reported in Victorian Water Accounts 2006/07.
g Streamflows calculated as gauged inflows from NSW plus Snowy Scheme diversions, plus inflows produced within Victoria.
h Does not include water savings that are being made for Snowy River.
i Water diverted by Snowy Scheme into Murray and Murrumbidgee basins each year on average (*Department of Industry, Science and Resources, 2000*).
j Refer: *Our Water Our Future*, temporary cap on new diversions (2,000 ML) from rivers entering the Gippsland Lakes until freshwater requirements of Gippsland Lakes are assessed.
k Primarily diverted to Melbourne.
l Includes the unused State Electricity Commission of Victoria (SECV) share of Blue Rock Reservoir and Lake Narracan.
m Volume supplied from the unallocated portion of Blue Rock Reservoir.



Dairy farming in Gippsland (Photographer: DSE)

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FIGURE 2.5 - Annual inflows into the Mitchell River Basin



Note: Flow over 2007/08 year is calculated using flow gauge data (Gauge no. 224203 Mitchell River at Glenaladale). The average in Table 2.1 differs as it is calculated using the Mitchell REALM model which does not yet include the 2007/08 year.

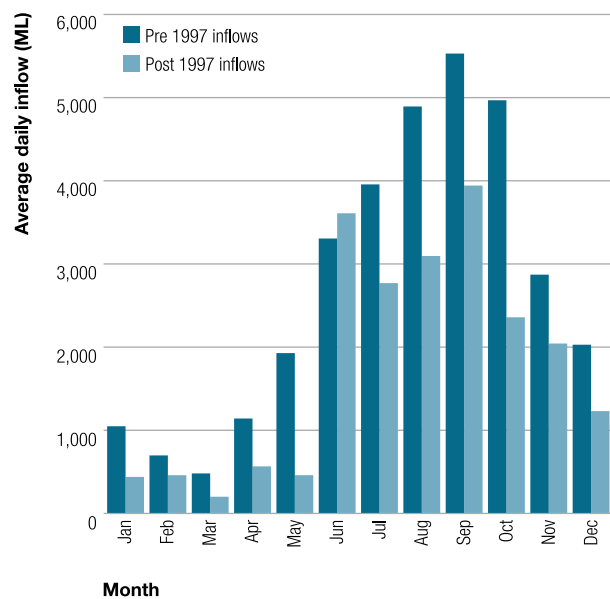
Returning water to the Snowy

When it was completed in 1974, the Snowy Mountains Hydro-electric Scheme diverted 99 per cent of the flow of the Snowy River at Jindabyne in south-eastern New South Wales. Based on historical climate data, the Snowy Scheme reduces the Snowy River's average annual flow into Bass Strait, southeast of Orbost, by approximately 53 per cent. The diverted water passes through a series of trans-mountain tunnels and power stations and is then released into the Murray and Murrumbidgee Rivers for irrigation.

In December 2000, an agreement was made between the Commonwealth, Victorian and New South Wales Governments to improve flows in the Snowy River. The agreement committed to achieving a target flow of 21 per cent of the river's natural flow at the confluence with Mowamba River downstream of Jindabyne by 2012. The agreement also included a longer-term target of returning an additional seven per cent of the river's natural flow, which would increase the target flow to 28 per cent.

The December 2000 agreement was followed by legal agreements that translated the percentage flow targets to target volumes. The joint government enterprise 'Water for Rivers', which was established in 2003 by the Victorian, New South Wales and Commonwealth Governments to identify and implement water saving projects to return environmental flows to the Snowy River system. The Water for Rivers enterprise is confident of achieving their target of obtaining 212 GL of water entitlement for the Snowy River by 2012.

FIGURE 2.6 - Average daily inflow in each month in the Mitchell River Basin prior to July 1997 (dark blue) and July 1997 onward (light blue)



Groundwater

Groundwater occurs when rain infiltrates the soil into aquifers – nature’s way of storing water underground. The Gippsland Region’s groundwater resources are extensive and generally of good yield and quality. Groundwater in the Gippsland Region is contained in layers of sedimentary sands, gravels, clays, limestones and coals that lie over bedrock and in the fractured rock aquifers. An example cross-section of an aquifer system is shown in Figure 2.7, while Figure 2.8 displays the groundwater units in the Gippsland Region.

The total volume of groundwater in the Gippsland Region cannot be accurately estimated as groundwater originates from numerous aquifers of varying extent and connectivity. Table 2.2 shows water level trends for each of the managed groundwater areas. Significant groundwater declines are occurring across the Gippsland Region in the deeper aquifers, as shown in Table 2.2 for the Rosedale

Groundwater Management Area, Stratford Groundwater Management Area and Yarram Water Supply Protection Area. Extraction of groundwater for dewatering of mines and for offshore oil and gas extraction is the main cause of the depletion. Groundwater extraction and below average rainfall are the cause of the declines in some areas of the Sale Water Supply Protection Area noted in Table 2.2. Groundwater levels in the shallow aquifers are generally stable.

Approximately 95,100 ML of groundwater was used in 2006/07 in the Gippsland Region groundwater management areas. Table 2.2 shows the availability of groundwater in these areas. In the six areas that are fully allocated groundwater is available only by trade. In the water supply protection areas groundwater is currently available only by temporary trade until management plans are developed. The majority of licensed entitlements in the Rosedale and Stratford Groundwater Management Areas are for mine dewatering.

TABLE 2.2 - Groundwater level status and availability in the Gippsland Region

Groundwater management unit	Water level status (January 2009)	Permissible consumptive volume (ML)	Licensed entitlement (ML)	Groundwater availability ^d
Denison Water Supply Protection Area	Stable	17,743	13,853	Temporary trade only ^b
Giffard Groundwater Management Area	Stable	5,665	5,665	Only by trade, as the licensed entitlement has reached the permissible consumptive volume
Leongatha Groundwater Management Area	Stable	6,500	1,471	By allocation or by trade
Moe Groundwater Management Area	Stable	8,200	3,864	By allocation or by trade
Orbost Groundwater Management Area	Stable	1,200	1,200	Only by trade, as the licensed entitlement has reached the permissible consumptive volume
Rosedale Groundwater Management Area ^c	Declining (over a period of decades)	22,313	21,241	By allocation or by trade
Sale Water Supply Protection Area	Local areas of decline	21,212	21,212	Temporary trade only ^b
Stratford Groundwater Management Area ^c	Declining (over a period of decades)	27,643	27,643	Only by trade, as the licensed entitlement has reached the permissible consumptive volume
Tarwin Groundwater Management Area	Stable	1,300	41	By allocation or by trade
Wa De Locke Groundwater Management Area	Stable	30,084	26,735	By allocation or by trade
Wy Yung Water Supply Protection Area	Stable	7,426	7,426	Temporary trade only ^b
Yarram Water Supply Protection Area ^d	Declining	25,317	25,317	Temporary trade only ^b

Notes:

- a Where the permissible consumptive volume has been reached in either a water supply protection area or groundwater management area, water can only be obtained via trade. If the permissible consumptive volume has not been reached, water can be obtained by new allocations or by trade.
b Permanent trade within water supply protection areas is not permitted until a groundwater management plan is in place, however temporary trade is permitted.
c Licences for mine dewatering are included in the licensed entitlement.
d Offshore oil and gas extractions are not included in the Yarram Permissible Consumptive Volume.

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FIGURE 2.7- Schematic map of aquifer systems in the Latrobe Valley³

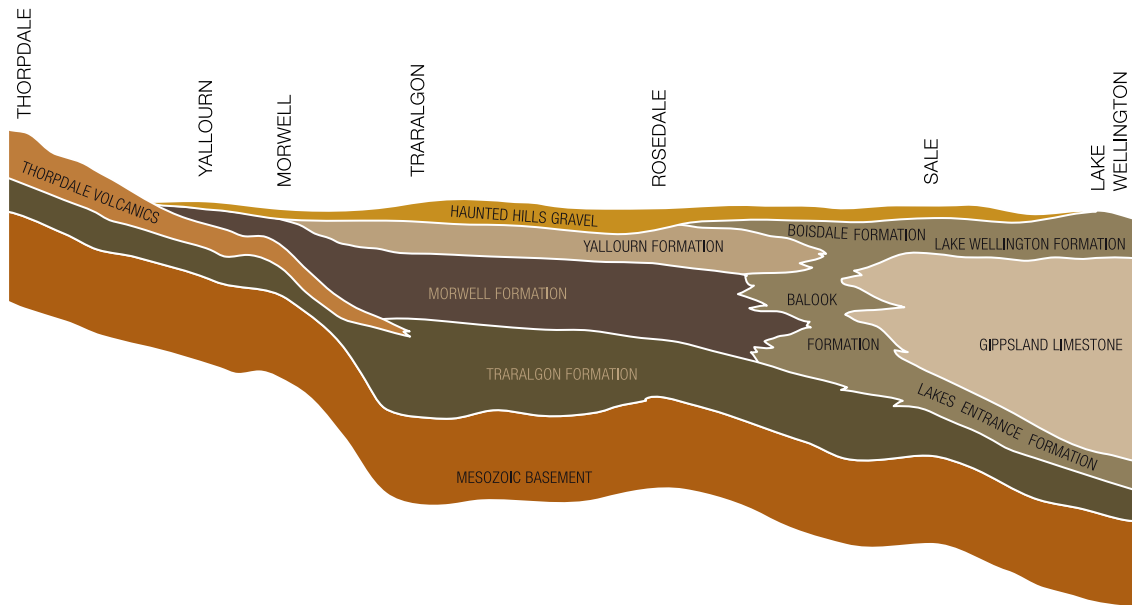
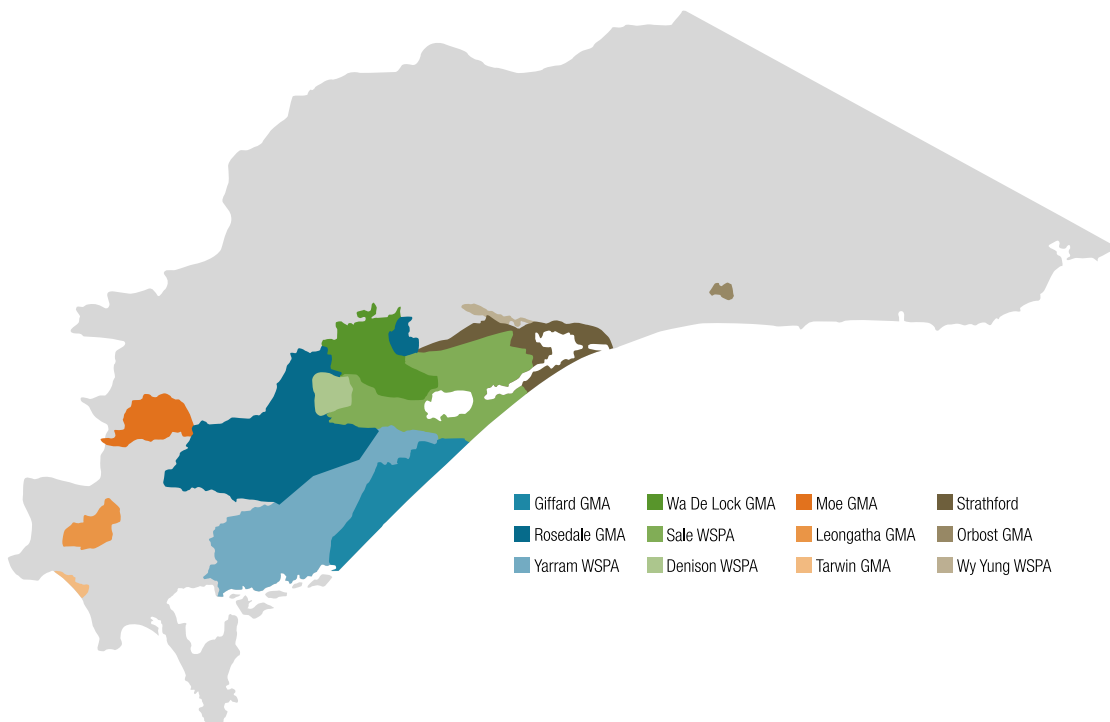


FIGURE 2.8 - Gippsland Region groundwater management areas and water supply protection areas



Alternative water sources

Alternative water sources including irrigation drainage water, recycled water and stormwater currently provide a non-potable water source for a range of uses in the Gippsland Region.

Drainage water

Drainage water is surface water or sub-surface water that is removed from farms by drains and pumps. This can either be to manage groundwater levels after a period of high rainfall, or to direct irrigation water once it has been used. Approximately 42,600 ML of drainage water was returned to the Thomson/Macalister River system in 2005/06. There have been increasing efforts to re-use drainage water on-farm in irrigation districts. On-farm efficiency programs implemented in the Macalister Irrigation District have decreased the level of irrigation drainage water leaving farms. For example, in 2005/06 on-farm programs reduced the amount of water entering the Thomson/Macalister system by approximately 4,200 ML.

Recycled water

Recycled water is derived from sewerage systems or industrial processes and treated to a standard that is 'fit for purpose' - that is, fit for its intended use. In the Gippsland Region, 4,228 ML of recycled water was used in 2007/08 (see Table 2.3).

East Gippsland Water recycles all its wastewater primarily for irrigation and beneficial environmental use. Gippsland Water is currently constructing the Gippsland Water Factory in the Latrobe Valley which is scheduled to supply approximately 3,000 ML of recycled water per annum for industrial use.

Wastewater is also produced by the power generation companies and industry, where approximately 46 GL per year is discharged to the Latrobe River (not shown in Table 2.3). Currently there is no obligation to discharge this water to the river.

Stormwater

Stormwater is defined as rainfall resulting from impervious surfaces such as roofs and roads within urban areas. In the Gippsland Region, local governments are responsible for managing stormwater infrastructure.

Stormwater discharged into local rivers and waterways can cause flooding, erosion and reduce water quality. But if captured and treated, stormwater can be a valuable alternative water resource and is becoming increasingly harvested - the collection and treatment of stormwater is now common practice in greenfield developments in Victoria. This is supported by the Sustainable Neighbourhoods provisions (Clause 56) of the Victoria Planning Provisions. At the household level, people with reticulated water supplies are also installing rainwater tanks as a secondary supply. Rainwater tanks are a common source of domestic water in rural areas outside of the reticulated water supply networks.

Urban stormwater and recycling projects can provide cost-effective local solutions, although larger scale projects have been found to be less cost-effective. Evaluation of the small scale recycling and stormwater projects funded by the Victorian Government through the Stormwater and Urban Water Conservation Fund across the State found that these projects have saved or replaced drinking water with stormwater often at less than \$1,000 per ML per year.

Demonstrating ways to manage stormwater and recycled water

The Victorian Government's Stormwater and Urban Water Conservation Fund has supported stormwater and stormwater/recycling demonstration at Lake Gutheridge in Sale and Wades Creek in Warragul.

TABLE 2.3 - Volume of wastewater produced and volume recycled⁴

Water Corporation	Wastewater produced in 2007/08 (ML)	Wastewater recycled in 2007/08 (ML)	Percentage recycled in 2007/08 (%)
Gippsland Water	23,140*	1,354	5.8%
South Gippsland Water	3,435	144	4.2%
East Gippsland Water	2,730	2,730	100%

Note: * Includes saline water discharges.

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Sharing our water resources – Victoria’s water entitlement and allocation framework

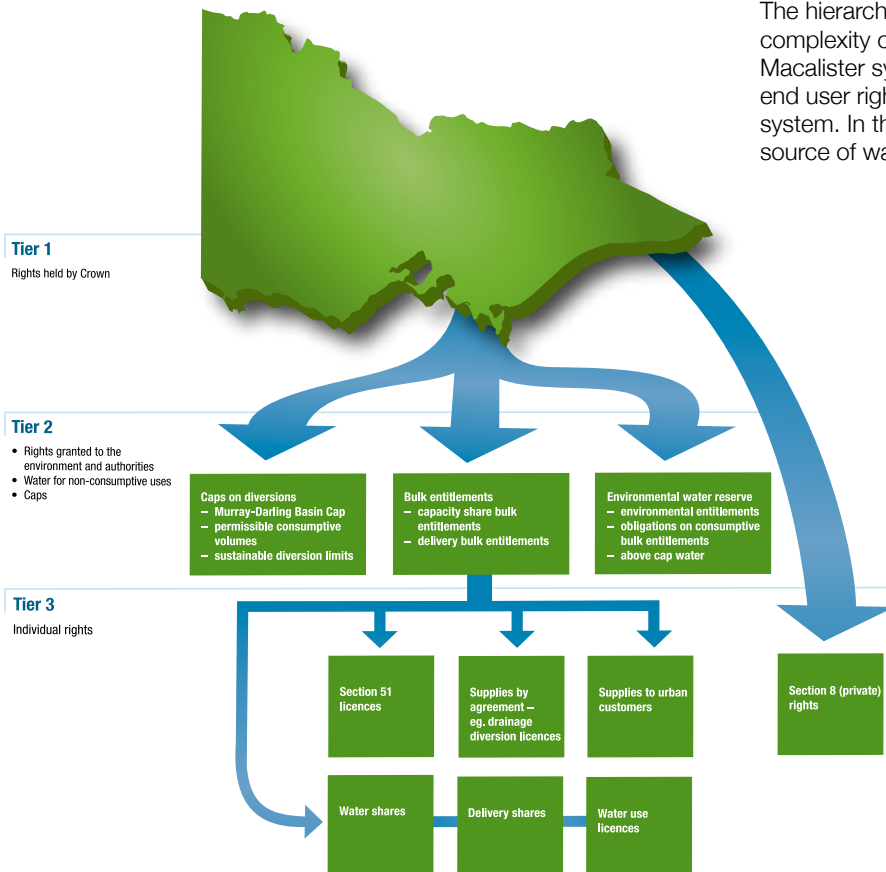
Victoria leads the nation in water management and has built its water allocation system on a framework of secure entitlements, the ability to adapt to changing conditions and supporting legislative powers to enable changes to entitlements only when necessary.

In 2004 when the Government released *Our Water Our Future*, it further improved the water allocation system by refining water entitlements, creating a legal right to water for the environment, and incorporating alternative water sources into the resource pool.

Victoria’s water entitlement system is made up of well defined rights to water sources and the establishment of markets to reallocate water between uses.

The Government retains the overall right to the use, flow and control of all of Victoria’s water resources (shown as tier 1 in Figure 2.9) and is responsible for issuing entitlements in accordance with the *Water Act 1989*.

FIGURE 2.9 - Victoria’s water entitlement and allocation framework



The Minister for Water may also qualify rights to water during extreme droughts when water shortages are declared.

The second tier of the framework shown in Figure 2.9 includes bulk entitlements ('capacity share bulk entitlements') and environmental entitlements. These entitlements are commonly defined in terms of shares of inflow and storage. At a regional level, bulk entitlements are issued to water corporations which are responsible for supplying water to towns, cities and irrigation districts for domestic, industrial and commercial uses. The Minister for Water has also issued bulk entitlements to three of the power generation companies in the Latrobe Valley.

The third tier of the framework shown in Figure 2.9 is individual rights that allow people to take and use water under a licence by agreement, water shares or water without a licence in accordance with the *Water Act 1989* Section 8 private rights (Section 8 rights). In the past the volume of water taken in accordance with Section 8 rights was generally considered not to be significant from a total water resource management perspective. However, the significance is growing because the amount of water used is increasing with rising populations and the proportion of water harvested is increasing with drier conditions.

The hierarchy of water entitlements allows for the complexity of large water systems such as the Thomson/ Macalister system, to be devolved into a series of simple end user rights to a share of the pooled large water system. In this way the essential linkage between the source of water and the end user rights is maintained.

Allocating surface water

Surface water supply systems in Victoria can be categorised into the following:

- Regulated systems - where streamflows are regulated through the operation of large dams or weirs. The rivers with significant flow regulation in Gippsland are the Thomson, Macalister and Latrobe river systems.

These regulated systems supply approximately 82 per cent⁵ of surface water use across Gippsland. Water corporations and the power generation companies in the Latrobe system take their water from the regulated systems under bulk entitlements. The water corporations then supply water to urban or rural customers. In regulated systems, rural customers generally hold water shares or licences.

- Unregulated systems - where streamflows are not controlled by major dams or weirs. Unregulated streams make up most of the length of rivers across Gippsland but supply less than 10 per cent of water used under entitlements in the region. Urban water corporations have bulk entitlements which allow them to harvest water from streams and store the water in on-stream or off-stream dams to supply towns. Individuals with water licences can pump water from unregulated streams for irrigation or commercial use.

Unallocated water

Gippsland is one of the few regions in Victoria where there are catchments which have water that has not been allocated to any user, including the environment, urban or rural water users. This means that water has not been allocated up to the identified sustainable diversion limit. A sustainable diversion limit is a conservative estimate that represents an upper limit on diversions.

Going beyond that limit would constitute an unacceptable risk to the environment without further appraisal of resource availability. Catchments with allocations below the sustainable diversion limit are located in the Mitchell/Avon, Tambo/Nicholson, South Gippsland and East Gippsland basins. An unallocated share of the Blue Rock Reservoir also exists in the Latrobe Basin.

Conversely, the Latrobe, Thomson/Macalister and Snowy River basins are fully allocated. The Minister for Water has declared a permissible consumptive volume in the Latrobe and Thomson/Macalister basins which ensures no new entitlements can legally be issued in these basins in excess of the permissible consumptive volume. A moratorium on new entitlements currently applies for the Thomson/Macalister and Snowy River basins and the Government is committed to improving their environmental water reserve as a high priority. These moratoriums apply until the environmental water reserves are defined and legally protected.

In fully-allocated systems, new surface water users can only access an entitlement through purchasing an entitlement from a willing seller. Trade of entitlements is subject to rules which protect the environment and reliability of supplies for existing users.

Where high value unregulated rivers are under ecological stress due to the existing level of extraction, or there is a demand for future development, a streamflow management plan may be developed to complement the environmental water reserves and ensure sustainable water sharing between all users. Priority rivers targeted for streamflow management plans in the Gippsland Region are the Avon, Tarra and Upper Latrobe Rivers. The need for these streamflow management plans is currently being reviewed and recommendations will be listed in the Draft Strategy.

TABLE 2.4 - Capped surface water systems in the Gippsland Region

Basin	Is the basin capped?	Is the basin fully allocated?	Nature of the cap
East Gippsland	Yes	No	State-wide sustainable diversion limits
Snowy	Yes	Yes	<i>Our Water Our Future</i> commitment
Tambo	Yes	No	<i>Our Water Our Future</i> commitment –
Mitchell	Yes	No	an additional 2 GL until the review
Avon	Yes	No	of the freshwater needs of the
			Gippsland Lakes is completed
Thomson/Macalister	Yes	Yes	<i>Our Water Our Future</i> commitment
Latrobe	Yes	No – there is an unallocated volume in Blue Rock Reservoir	<i>Our Water Our Future</i> commitment
South Gippsland	Yes	No	State-wide sustainable diversion limits

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Allocating groundwater

Aquifers in the Gippsland Region which are either being significantly used, or have a potential for significant use have been defined as groundwater management areas or as water supply protection areas to help manage the resource. Groundwater management areas are assigned a permissible consumptive volume, which caps the amount of water that can be allocated for licensed extraction. Water supply protection areas require management plans to be developed to reduce overuse and to stabilise groundwater levels.

In the Gippsland Region there are four water supply protection areas and eight groundwater management areas. Six of these areas are now fully allocated (see Table 2.2).

Groundwater extraction outside the defined management areas is not capped and are considered to have a low potential for development and would mainly be used for stock and domestic purposes. All groundwater extracted for irrigation or commercial use in Victoria requires a licence, whether inside or outside defined management areas.

The Macalister Irrigation District

The Macalister Irrigation District covers approximately 53,000 hectares of farmland adjacent to the Macalister, Thomson and Avon rivers from Lake Glenmaggie to near Sale. Approximately 33,500 hectares is currently used for irrigation, and of this 90 per cent is under pasture for dairying and raising beef cattle.

The Macalister Irrigation District is centred on Maffra where the Murray Goulburn Cooperative processes much of the milk produced by the dairy farmers. Other important centres are Stratford, Heyfield and Sale.

Water is supplied to the Macalister Irrigation District by Southern Rural Water which harvests water from the Macalister River at Lake Glenmaggie and from the Thomson River at Cowwarr Weir.

On July 1 2008, the Victorian Government 'unbundled' water rights for the Macalister Irrigation District, giving individuals more flexibility to manage water as a valuable asset separate from land. Unbundling is consistent with the actions of the *National Water Initiative*. As a result, water rights have now been separated into three components:

1. Water share – an entitlement to an ongoing share of water available from a particular supply source. This amount is equal to the previous 'water right'. Water shares are classified as either high-reliability or low-reliability.
2. Share of delivery capacity – an entitlement to have water delivered to a property. This is equal to the previous delivery service.
3. Water-use licence – a licence to use water for irrigation on a particular property (including any site-specific conditions on use).

The water shares issued in the Thomson/Macalister system includes, 144,200 ML of high reliability, 68,740 ML of low reliability and up to 62,000 ML of spill entitlements.⁶

Seasonal allocations for high and low-reliability water shares

Each year, irrigators receive a seasonal allocation which is a share, proportional to their entitlements, of the available water resources from Lake Glenmaggie and the Thomson River.

Before allocations are made, it is necessary to set aside sufficient water to fill the irrigation channels and cover losses (from seepage and evaporation). When making seasonal allocations, water is first provided to high-reliability shares. Water is allocated only if it is available in storages or guaranteed from streamflow. This means that during times of low inflows or drought, allocations may be low or even zero at the start of the irrigation season (usually in August), then increasing throughout the season as flows into storages occur during winter and spring.

Water is allocated for low-reliability shares after allocations to high-reliability shares reach 100 per cent. Previously, low-reliability shares were allocated as 'sales' water, and customers paid only for the volume of sales water actually used. In July 2008, for the Macalister Irrigation District customers, sales water was converted to low-reliability water shares. These are allocated on the same basis as sales water, however they have more legal protection and are fully tradeable and recognised separately to land.

Spill entitlement

When Lake Glenmaggie spills, Southern Rural Water can declare a period that spill entitlement is available and the water delivered to irrigators during this period is not counted as part of their seasonal allocation. Similarly, when water is available in other parts of the Thomson/Macalister system that cannot be stored, Southern Rural Water can declare a period that localised spill entitlement is available and the water received by irrigators in this area during this period is not counted as part of their seasonal allocation.

How water is used in the Gippsland Region

The following section outlines the major uses of water in the Gippsland Region, including rural, urban, power industry and oil and gas extraction.

Water use in agricultural industries

The Macalister Irrigation District is the largest irrigation area in southern Victoria. Reliable water supplies from the Macalister and Thomson rivers underpin irrigated agriculture in this district.

Lake Glenmaggie is the main source of supply for the Macalister Irrigation District. This storage has a small capacity of 177,000 ML relative to the average annual river flow of nearly 500,000 ML per year. Irrigators rely on the reservoir refilling by late spring to supply their water needs through summer and autumn.

The Macalister Irrigation District also takes water from the Thomson River at Cowwarr Weir. It has a share of the minimum passing flows released to the river from Thomson Reservoir. It can also harvest unregulated flows in the Thomson River and has a small share of the Thomson Reservoir which serves as a drought reserve when there is a shortage of water in Lake Glenmaggie.

Considerable volumes of water are lost in the open channel system in the Macalister Irrigation District due to leakage and seepage, evaporation and outdated measurement and irrigation delivery systems. On average, approximately 32 per cent⁷ of all water used by the Macalister Irrigation District is lost each year. Modernising this system, will result

in decreased losses and savings that can be allocated to consumptive users or the environment.

Irrigation also occurs in the Gippsland Region when water is being sourced directly from rivers or from groundwater. Southern Rural Water is responsible for licensing the take and use of water from waterways, springs, dams and groundwater in the Gippsland Region.

Dairy farming is the main agricultural activity using groundwater in the region, using an estimated 30,000 ML primarily for irrigation use within the groundwater management areas and water supply protection areas in 2007/08. The vegetable industry is also important in the Gippsland Region, including market fresh vegetables and value-added processing.

Water from waterways and groundwater systems is used across Gippsland for domestic and stock purposes. There are an estimated 5,049 domestic and stock bores located within the groundwater management areas and water supply protection areas in the Gippsland Region, which extracted an estimated 10,098 ML of groundwater in 2006/07. While constructing a groundwater bore or using groundwater for commercial or irrigation purposes requires a licence, using groundwater for domestic and stock needs does not currently require a licence and is not metered. This represents around nine per cent of total groundwater used in the groundwater management areas and water supply protection areas across the Gippsland Region.

Many agricultural businesses across the Gippsland Region rely solely on rainfall, including livestock production businesses and some dairy businesses.



Irrigation by the Avon River (Photographer: DSE)

Resource Review

Water use in cities and towns

Urban water use is made up of household and industrial consumption, including some of the water used in power generation. Up to 349 GL a year, equivalent to 44 per cent of the total volume used is available for use in the urban supply systems (see Table 2.1). In addition to drinking water supply, about 4.2 GL per annum of recycled water was used in 2007/08 for non-potable uses within the urban supply systems.

In the Gippsland Region, water is supplied to 111 towns, by urban water corporations.

A large part of the water resources of the Thomson Reservoir is transferred to Melbourne's water supply system.

Urban water supply systems within the Gippsland Region are characterised by many small, widely dispersed, stand alone systems. Gippsland Water's system is the largest urban water supply system in the Latrobe Valley, which includes a large component of power generation and industrial use.

Many urban water supply systems in the Gippsland Region rely on small storages to fill every year. These small storages have historically provided a reliable water supply on the basis that inflows can generally be relied upon every year. The low flows of the previous 12 years has demonstrated how reliant some supply systems in the Gippsland Region are on getting adequate winter inflows every year, in order to meet demand in the following summer. In the 2006/07 year, winter inflows were so low that little water was harvested in the storages, exposing towns to severe and lengthy water restrictions.

Water for urban systems is sourced primarily from rivers, however some urban centres, including Sale, draw on groundwater resources for their urban supply. Approximately 2,554 ML of groundwater was used for urban supply in 2006/07, which was nine per cent of all water used for urban supply in the region. Groundwater may also be used as an alternative urban supply source, including during times when bushfires reduce water quality or when drought reduces the availability of surface water. Table 2.5 provides more information regarding the region's urban water use.

Industrial and commercial use (ie. non-residential use) accounts for 46 per cent of total urban water use in the Gippsland Region. Table 2.6 shows how non-residential urban water is used.

In most urban supply systems in the Gippsland Region, distribution losses are relatively small proportion of the water delivered through the pipe networks. Most urban water corporations have programs in place to reduce losses caused by leaky and broken pipes.

Households in the Gippsland Region that are located outside of the reticulated urban supply systems rely on water sources such as rainwater tanks and groundwater bores for their domestic water needs.

TABLE 2.5 - Urban water supplies and use in the Gippsland Region⁸

Water Corporation	No. of towns supplied	Main Towns	Population	Connection	Volume supplied (2007-08) ^a	Residential use in 2007/08 (L/person/day) ^b	Main water sources	Largest storages
East Gippsland Water	42	Bairnsdale, Lakes Entrance, Orbst	30,741	22,816	4.4 GL	255	Mitchell River	Woodglen Storages
Gippsland Water	41	Traralgon, Morwell, Moe, Sale, Warragul	133,500	62,882	60.1 GL	210	Tyers River, Tanjil River	Moondarra Reservoir, Blue Rock Reservoir
South Gippsland Water	28	Leongatha, Korumburra, Wonthaggi	27,000	18,641	4.7 GL	178	Lance Creek, Ruby Creek	Lance Creek Reservoir

Notes:

a Volume supplied at customer meters, does not include any system losses or Non Revenue water.

b The average water consumption in litres per person per day has been calculated using the reported permanent population of the relevant corporation and the annual residential water consumption reported by the water corporation in 2007/08.

TABLE 2.6 - Non-residential component of urban water use in 2007/08⁹

Water Corporation	Non Residential Use in GL in 2007/08 (% Total Use) ^a	Examples of major industries
East Gippsland Water	1.5 GL (35%)	Food processing
Gippsland Water	49.7 GL (83%)	Power generation, paper manufacturing, dairy manufacturing
South Gippsland Water	2.9 GL (63%)	Dairy manufacturing, meat products

Note: ^a Includes Non Revenue water. Leakage is a component of Non Revenue water, including leakage within residential water distribution networks.

Benefits for Tourism

Public land and waterways are major resources for outdoor recreation. The ocean and lakes and lower reaches of the rivers are key attractions for fishing, swimming, sailing and other recreational boating. The higher reaches of the rivers are used for recreational angling, canoeing, kayaking and rafting and their banks provide attractive bush camp sites.

Tourism visitation to the Gippsland Region for the 2008 calendar year was 1,481,000. This is made up of domestic and international visitors who stayed at least overnight in the region. This makes the industry an important economic asset to the community. East Gippsland includes some of the most significant and concentrated areas for outdoor activities in Victoria.



Boating, North Arm, Lakes Entrance (Photographer: DSE)

Water use by the power industry

The Latrobe Valley coal-fired power stations typically provide Victoria with 85 per cent of its electricity. The power stations need large volumes of lower quality water for cooling as well as a small volume of high quality water for their boilers and on-site water use.

Almost all of the surface water supply for Morwell (Energy Brix) and Hazelwood (International Power) power generation companies is supplied by Gippsland Water. Yallourn (TruEnergy), Loy Yang A (Great Energy Alliance Corporation) and Loy Yang B (International Power / Mitsui) power generation companies have their high quality water needs supplied by Gippsland Water, but pump their own lower quality cooling water from the Latrobe River. The bulk entitlements¹⁰ in the Latrobe system provide power generators with a proportional share of the storage capacity and inflows of Blue Rock Reservoir and Lake Narracan. The power generation companies bulk entitlements do not guarantee a minimum annual volume and they must therefore manage within their individual shares. Surface water use for power generation is typically around 95,000 ML per year.

In addition to surface water, Yallourn, Morwell and Loy Yang A power generation companies hold licences to pump a combined total of approximately 45,000 ML per year of groundwater to drain and stabilise their open cut coal mines. In recent years the volume of groundwater extracted has been up to about 30,000 ML per year, which is pumped from the Yallourn, Morwell and Traralgon aquifers.

The pumped groundwater is mixed with used cooling water and treated before either being recycled for cooling purposes or discharged to the Latrobe River under an EPA licence. Low quality effluent from the power generation companies ash disposal system is discharged to Bass Strait via Gippsland Water's saline waste outfall pipeline.

Looking forward, the power industry will potentially be subject to significant changes over the coming years which will, in turn, impact on its water use and demands. Relevant factors include the Commonwealth Government's Emissions Trading Scheme and its impact on brown coal electricity generation and the future implementation of carbon capture and sequestration technologies. Close engagement with the power industry will be required during development of the Draft Gippsland Sustainable Water Strategy, to ensure we can adequately consider these issues in the context of planning for our future water needs.

Resource Review

Water use by oil and gas production

Offshore oil and gas extraction involves pumping large amounts of groundwater from hydrocarbon reservoirs in the Latrobe Aquifer which extends kilometres out to sea under the sea bed. As oil, gas and water are extracted, water in the aquifer further onshore moves outwards to replace the extracted water. The effective volume of water extracted offshore peaked at 95,000 ML per year in the period 1995-2000¹¹, or about four times the amount pumped by the power stations. In 2004 the Hatton Report identified that offshore oil and gas production had contributed to groundwater declines in the Latrobe Aquifer. This has adversely affected farming businesses reliant on this aquifer system. A joint State and Federal funded assistance package is being implemented to assist irrigators impacted by the falling water levels.

Onshore gas processing also uses groundwater. The Longford gas plant, south of Sale, extracts groundwater from the Latrobe Aquifer to use as process water and in other parts of its operations. In 2006/07, approximately 1,000 ML of groundwater was supplied to the Longford plant.

Intercatchment transfers

Not all water sourced from the Gippsland Region is used there. There are several instances where water is channelled or piped across a catchment boundary for use elsewhere. The major example is the transfer of water for Melbourne from Thomson Reservoir. Table 2.7 shows the current and historical transfers across catchments that occur on a regular basis (ie. every year), as well as those that occurred every few years. An example of a transfer on a regular basis is supplying Warragul and Noojee from Tarago Reservoir. An example of a transfer that has occurred only a few times is supplying some irrigation needs in Werribee from the Thomson Reservoir, which has only occurred twice.

Infrequent transfers are often made as drought contingency measures.

TABLE 2.7 - Transfers between catchments (ML/year)^a

Catchment	Transfer from -								
	Mitchell	Thomson	Macalister	Latrobe	Tarago ^b	Snowy	Powlett	Tarra	Agnes
Transfer to -	Tambo	1,600 ^c							
	Avon		22,500 ^d	21,500 ^e					
	Thomson			63,200 ^e	##				
	Latrobe		18,100 ^d	25,500 ^e		3,000 ^f			
	Yarra		167,800 ^d						
	Werribee		#						
	Murray						580,000 ^g		
	Murrumbidgee						560,000 ^g		
	Bass							300 ^h	
	Coastal							760 ⁱ	60 ^j

Notes:

- a Volumes presented are estimated from a range of information sources and are indicative only.
- b Bunyip River catchment.
- c Supply to Lakes Entrance and Bruthen from the Bairnsdale system.
- d Supply to irrigators within the Macalister Irrigation District.
- e Water supplied from the Macalister River to areas of the Macalister Irrigation District not located within the Macalister catchment area.
- f Supply to Warragul and Noojee from Tarago/Bunyip River catchment.
- g Annual average releases from the Snowy Scheme to the Murray and Murrumbidgee (Department of Industry, Science and Resources, 2000).
- h Transfer from Lance Creek Reservoir to Candowie Reservoir. Estimated from transfers over recent years. Transfers have varied considerably from year to year.
- i Water supplied from Powlett River catchment to Inverloch and Cape Patterson on average each year.
- j Water supplied from Tarra River catchment to Port Albert.
- k Water supplied from Agnes River catchment to Port Welshpool.
- # Transfer to Werribee from the Thomson is occasional and has only happened in 2006/07 and 2007/08.
- ## Between 1971 and 1976 before Thomson Reservoir was built, 23 GL was taken from the West Tanjil to the Thomson River where it was transferred to Melbourne via the Upper Yarra tunnel.

Water provided for the environment

The environmental water reserve (EWR) is the legal term used to describe the water set aside by law to meet environmental benefits through:

- statutory environmental entitlements (such as a volume of water held in storage)
- conditions on bulk entitlements, licences and permits (such as passing flows below a storage)
- the establishment of limits to diversions (such as permissible consumptive volumes and caps, as discussed under Victoria's water entitlement and allocation framework section of this chapter).

Surface water

The existing EWR was established taking into account existing consumptive entitlements. This means under existing arrangements, some systems may not have enough water to maintain ecological health of the rivers and wetlands.

The Government has allocated responsibilities for the operational management of the EWR to catchment management authorities.

To ensure the EWR achieves the best environmental outcomes, it will be managed as part of an integrated river and wetland protection and restoration program.

Only a small proportion of the water that provides environmental benefit can be actively managed by catchment management authorities to maximise environmental benefits. In regulated systems (Thomson/Macalister and Latrobe systems), passing flows are the flows that a water corporation must pass through its reservoirs before it can take any water for consumptive use. In unregulated systems, passing flows are established through licence conditions including rostering and restriction rules. Passing flows may be, and have been qualified (in order to meet critical human needs) during extreme droughts when a water shortage is declared. For example, the Thomson River environmental entitlement is currently qualified to mitigate the risk of Melbourne

entering Stage 4 water restrictions in the period before the desalination plant is commissioned.

In regulated systems a significant proportion of the EWR is made up of spills from storages in wet years. In dry years when storages don't spill, the EWR is substantially reduced and as such is particularly vulnerable to long-term reductions in streamflows through climate variability or climate change.

The EWR cannot be measured as a volume of water for the environment. Rather, it is a flow regime including the timing (when a flow occurs), frequency (how often a flow occurs), duration (length of time) and magnitude (size of flow). As a result, the amount of water in the EWR differs from river to river and from year to year. In addition to maintaining environmental values, the EWR supports recreational and cultural values.

A few environmental entitlements have been allocated to provide flexibility to deliver flows in Gippsland river systems. The current entitlements are listed in Table 2.8. In addition to Table 2.8, 5 GL has been obtained from water savings in the Macalister Irrigation District which will be converted into an environmental entitlement for the Macalister River. *Our Water Our Future* also committed to providing an additional 8 GL for Thomson River and 2 GL for Macalister River by 2014.

The Snowy River entitlements are assigned two-thirds to the Snowy River and one third to the River Murray. The water for the Snowy River entitlements came from a number of recent water savings projects within the Murray and Goulburn water supply systems. The entitlements will be increased as additional savings are made for example through the Central Goulburn Channels 1-4 Modernisation Project.

An assessment of the environmental flow requirements of the Thomson and Macalister rivers was undertaken by the Thomson Macalister Environmental Flows Task Force using the FLOWS methodology. The additional annual average volume required to meet the environmental flow recommendations was approximately 57 GL.¹²

TABLE 2.8 – Environmental entitlements for Gippsland systems^a

Title of entitlement	Entitlement
Bulk Entitlement (Thomson River - Environment) Order 2005 ^b	10,000 ML/yr
Bulk Entitlement (Goulburn System – Snowy Environmental Reserve) Order 2004 ^c	14,812 ML/yr
Bulk Entitlement (River Murray – Snowy Environmental Reserve) Conversion Order 2004 ^c	6,988 ML/yr
Bulk Entitlement (Broken System – Snowy Environmental Reserve) Conversion Order 2006 ^c	990 ML/yr

Notes:

- a This table does not include water savings from the Macalister Irrigation District Channel Automation works which will be allocated to the environment.
The total volume saved to date is estimated to be 10 GL, of which 5 GL has been confirmed and will be included in an environmental entitlement later in 2009.
- b Annual unrestricted entitlement.
- c Entitlement equivalent to high reliability water shares in the respective systems.

Resource Review

The Task Force recognised that non-flow related river improvements were needed and by delivering both, the total outcome for the rivers would be improved. In *Our Water Our Future* the Government committed to providing an annual average of 25 GL of additional environmental flows to improve the health of the Thomson River, Macalister River and the Gippsland Lakes. It was found that this volume would provide improved flows in most years and meet many of the Task Force recommendations. The adaptive approach taken maximises the ecological benefits of the environmental flows and includes a ten year monitoring program that will enable the restoration program to be reviewed against the ecological objectives.

In 2007 a FLOWS study was undertaken in the Latrobe River system, which estimated that an additional annual average volume of approximately 38 GL would be required to meet the environmental flow recommendations.

The West Gippsland Catchment Management Authority has since undertaken extensive meander reinstatement in the lower Latrobe, which will alter the environmental water requirements. Given the modified nature of the river, the Central Region Sustainable Water Strategy took an adaptive approach and assigned 10 GL of the unallocated share of Blue Rock Reservoir to the Latrobe River as the basis for a seven year research program. The aim of the research program is to determine the most effective combination of environmental water and river restoration works to meet the river health objectives of the Latrobe River.

In unregulated rivers where there are no major dams that control releases, the Government aims to provide ecologically sustainable environmental water reserves primarily through management of existing diversions. However, some systems experience increased ecological stress due to water extraction, especially in summer months. In these systems the aim is to manage summer extractions to reduce stress. The management of unregulated rivers may be through local management rules or streamflow management plans. Streamflow management plans aim to achieve a sustainable EWR in high value, high risk rivers. The priority rivers identified in *Our Water Our Future* for streamflow management plans in the Gippsland Region are the Avon, Tarra and Upper Latrobe Rivers.

The importance of flow for healthy rivers

The pattern of flow (or 'flow regime') plays an important role in river ecology and provides a range of services and benefits for people. Higher flows stimulate fish breeding, maintain estuary openings and provide additional recreational opportunities. Low summer baseflows help maintain fish refuges and connect instream habitats. Floods in spring regenerate floodplains and wetlands including agricultural soil and replenish the river channel.

About 20 per cent of the available average annual river discharge to the Gippsland Lakes is extracted as surface water for agricultural, industrial and domestic purposes before it reaches the Lakes. This is predominately from the regulated systems, and the figure is greater in dry years. Groundwater extractions are also an important factor in the overall water balance of the river systems that drain into the Gippsland Lakes.

Overall river and stream condition

The Index of Stream Condition¹³ was developed by the Department of Sustainability and Environment to provide a consistent state-wide picture of the environmental condition of rivers and streams. The Index integrates the condition of river hydrology, water quality, vegetation in the streamside zone, instream habitat, aquatic life and condition of the bed and banks.

Figure 2.10 shows the percentage length of rivers and tributaries in good or excellent condition (a score of 37 or above results in a condition rating of good or excellent).

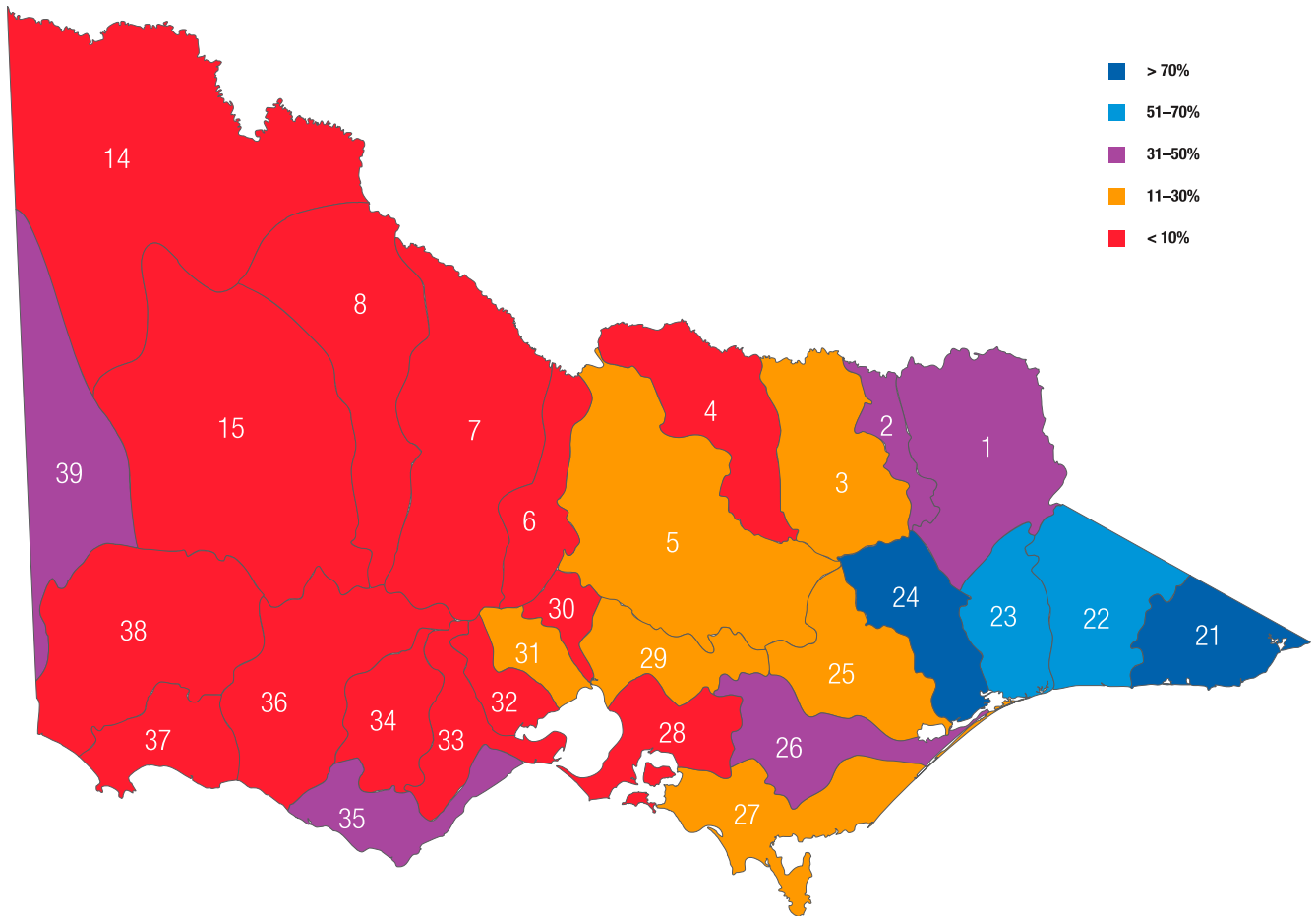
Groundwater

Groundwater is part of the water cycle. It flows into and out of rivers, streams, estuaries and wetlands. At the same time, vegetation pumps groundwater through its roots. Rivers, streams, estuaries, wetlands and vegetation dependent on the supply of groundwater are described as groundwater dependent ecosystems. The water requirements of groundwater dependent ecosystems may be dependent on one or more of groundwater quality, level and flux or flow of water through the aquifer. These ecosystems use of groundwater needs to be considered as part of the overall sharing arrangements of the resource.



Thomson River (Photographer: DSE)

FIGURE 2.10 - Percentage length of major rivers and tributaries in each river basin in good or excellent condition



1 Upper Murray	6 Campaspe	21 East Gippsland	26 LaTrobe	31 Werribee	36 Hopkins
2 Kiewa	7 Loddon	22 Snowy	27 South Gippsland	32 Moorabool	37 Portland
3 Ovens	8 Avoca	23 Tambo	28 Bunyip	33 Barwon	38 Glenelg
4 Broken	14 Mallee	24 Mitchell	29 Yarra	34 Corangamite	39 Millicent
5 Goulburn	15 Wimmera	25 Thomson	30 Maribyrnong	35 Otway	