Water Resource Outlook

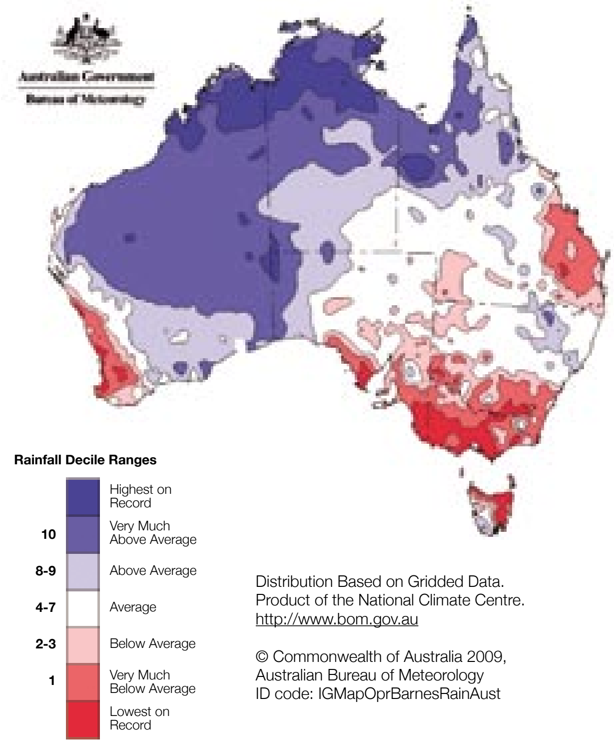
Historically, the Gippsland Region has experienced relatively reliable rainfall, being one of the wettest areas in Victoria. However Gippsland, like the rest of Victoria, has been significantly impacted by the persistently dry conditions experienced over the last 12 years, with the lowest inflows on record being observed in many streams across the region in 2006.

A major issue in considering the water resource outlook over the next 50 years is whether the drier conditions of the past 12 years simply reflect natural climatic variability, the impacts of climate change or both these factors.

In addition to climate variability and climate change there are a range of other factors that will influence water availability within Gippsland over the next 50 years, including land use change and bushfire impacts.

The Gippsland Region Sustainable Water Strategy is a Victorian Government initiative to respond to climate variability, climate change, and other pressures on water resources.

Figure 3.1 - Australian rainfall deciles 1 October 1996 to 31 May 2009



Drought, climate variability, and climate change

The climate of the last 12 years

Over the last 12 years, rainfall across almost all of Victoria has been well below average (see Figure 3.1). There has also been a lack of very wet years to offset the dry years and a change in the seasonality of rainfall, with the biggest decreases in rainfall occurring in autumn and winter. This has caused catchments to 'dry out', so that even when rain does occur, a large proportion is required to simply saturate the soil, and less run-off is created as a result. While much of southern Victoria, including west Gippsland, has experienced the lowest 12 years of rainfall on record, conditions have been slightly less extreme in central and eastern Gippsland, with rainfalls falling into the below average and very much below average categories.

As a rule of thumb, a decrease in rainfall can be expected to result in a decrease in run-off that is two to three times the decrease in rainfall, with the higher multiplication factors tending to occur in drier climates.[14] Over the last 12 years, multiplication factors across the State have generally been higher than expected, which is likely to reflect the change in rainfall characteristics as well as the overall decline in annual amounts. The below-average rainfall of 2006/07 resulted in record low streamflows throughout much of the State, including most of the Gippsland Region.

Victoria's water entitlement and allocation framework and water management and planning processes have been designed to cope with drought but the duration and severity of the low flows over the past 12 years has depleted storages. This has resulted in severe and prolonged restrictions on rural and urban supplies, and increasing stresses on environmental values. For example, environmental assets such as the lower Latrobe wetlands and the Gippsland Lakes are being threatened by the prolonged low flows.

Figure 3.2 shows the average annual inflows into south Gippsland river systems over the historic record. It shows that there has been a 41 per cent reduction in average flows since 1997 (from 611 GL to 359 GL), with record low inflows in 2006/07 (106 GL). There have also been no years with flows above the long-term average.

3

Climate change or variability?

Climate change poses the biggest risk to the region's water supplies for the future. The Intergovernmental Panel on Climate Change concluded in 2007[15] that the warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level. The panel also concluded with a very high level of confidence that the warming is due to human activities.

The Victorian Government is undertaking a significant amount of work to investigate climate change and associated impacts in Victoria (see www.greenhouse.vic.gov.au and www.mdbc.gov.au/subs/seaci). The Victorian Government is also committed to addressing the drivers of global warming by reducing greenhouse gas emissions and preparing for further changes to our climate. This work is being driven by the Victorian green and white papers on climate change (see www.climatechange.vic.gov.au).

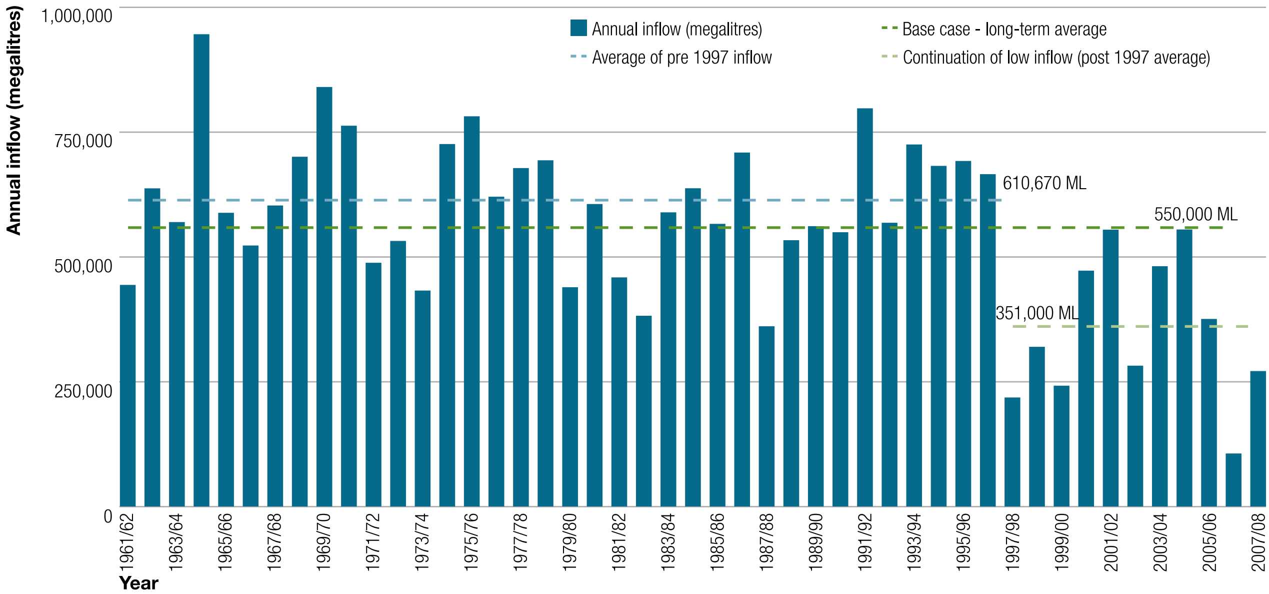
Changes in seasonal rainfall and streamflow patterns

It is possible that the past 12 years has simply been an episodic dry period, similar to those experienced in the past – notably between 1895 and 1903 and between 1936-1945. The reduction in average annual rainfall across the State over the last 12 years (around 12 per cent) is in fact around the same as during 1936-1945, but this earlier drought period was not characterised by the large reductions in autumn rainfall that we have seen in recent years. As a consequence of the changed rainfall characteristics the current period of low inflows is more severe than these earlier events. Across the Gippsland Region, the reductions in streamflows over the last 12 years are between about 23-50 per cent of the long-term average. This is around the magnitude of reduction in flows that would be expected under medium to high climate change scenarios by the middle of the century.

Are we experiencing a step change?

It is also possible that the low inflows experienced since 1997 represent a permanent step change in reservoir inflows. A similar step change occurred in southwest Western Australia in 1975 when inflows were reduced by about 50 per cent, and up to 70 per cent in the past 10 years (see Figure 3.3). Extensive research into the causes of this step change in southwest Western Australia indicate it is likely to be the result of a combination of several influences, including the greenhouse effect and natural variability.

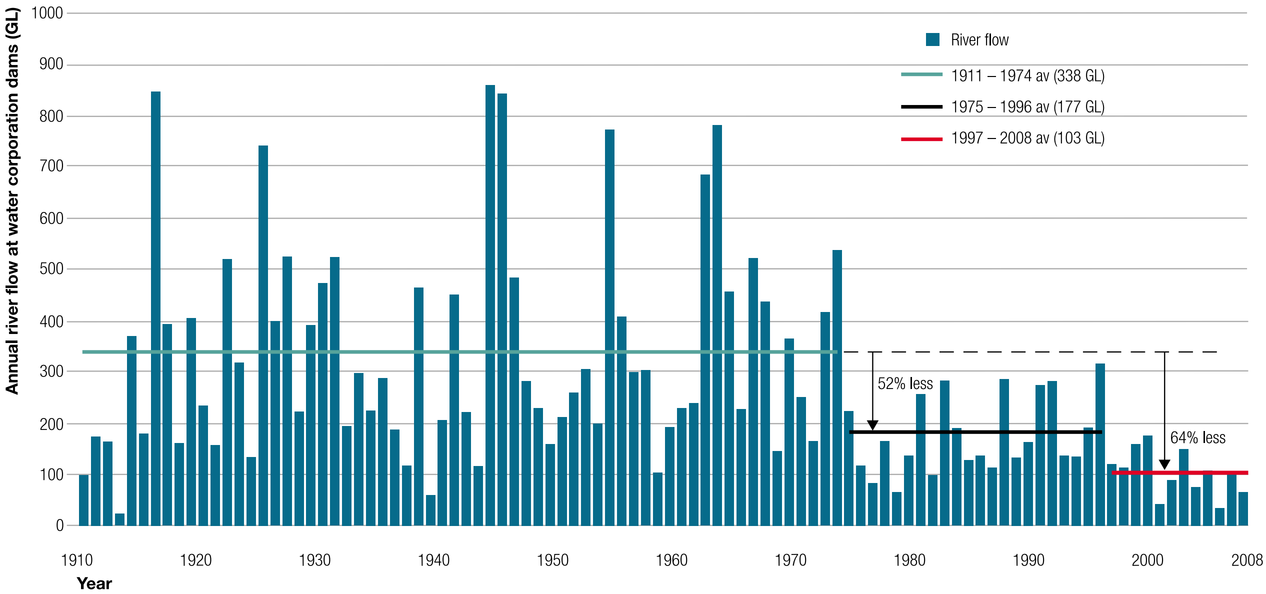
Figure 3.2 - Annual inflows into South Gippsland catchments*



Note: *Total inflows for Bass, Powlett, Tarwin, Agnes and Tarra systems only. Data sourced from resource allocation modelling, except for 2007/08 which has been estimated from streamflow gauge records.

Water Resource Outlook

Figure 3.3 - Reduction in inflows to Perth storages since 1975[16]



More recent research conducted as part of the South Eastern Australian Climate Initiative (SEACI) has shown that the recent decreases in rainfall are linked to an increasing trend in pressures across southern Australia. These increases in pressure appear to be linked primarily to an intensification of the sub-tropical ridge (the mid-latitudinal belt of high pressures at around 35-40 degrees south), which in turn appears to be linked to global warming.

The research has shown that the increasing pressures are likely to be also influenced by changes in the Southern Annular Mode (SAM). This is a mode of climate variability operating on around a 10-14 day time-scale that involves an alternation of high and low pressures and associated storms and windiness between the mid and high latitudes south of Australia. In recent decades SAM has been trending more positive (ie. higher pressures more often across southern Australia). These trends have been linked to global warming, ozone depletion and the influence of northern hemisphere aerosol pollution (through its impacts on the Indian Ocean).

Further research will be conducted as part of SEACI over the next three years to clarify the reasons for the recent dry conditions. Based on this research and a more detailed evaluation of the suitability of the various global climate models for application in southeastern Australia, improving future projections of climate and water resource availability out to 2070.

It may take decades before we know if the low inflows of the past 12 years are part of the normal cycle of climate variability, or whether they are due to, or partly a result of, human induced climate change and/or some other influencing factors. Regardless of the cause, it is important to ensure that we have reliable, secure water supplies in the event of continuing dry conditions.

Changes in extreme rainfall events

While climate projections suggest that average water availability will be reduced as a result of climate change in the future, studies have also shown a projected increase in extreme rainfall events across some parts of Australia.[17] For Gippsland, the changes in extreme rainfall events projected by CSIRO and the Bureau of Meteorology are an increase in the summer and autumn seasons but no change in winter and spring, when most flooding historically occurs. The implications of any change to flooding frequency are being considered through the Government's review of floodplain management arrangements.

Changes in temperature

Temperature increases resulting from rising levels of greenhouse gases in the atmosphere are likely across the Gippsland Region. Generally, as temperature rises evaporation increases and water lost through transpiration from vegetation also increases, unless water availability becomes a limiting factor.

These increased demands for water from forests and on farmland will reduce the volume of surface water run-off and groundwater recharge across the landscape. Crop water demands also increase in response to increases in temperature.

Higher temperatures will also increase the risk of bushfires, as discussed later in this chapter.

Other pressures and risks

In addition to the risks associated with climate variability and climate change, Gippsland's water resources and river and wetland health are under pressure from a range of other factors, including:

- population growth
- limits to surface water and groundwater allocation
- landuse changes
  - vegetation cover
  - timber plantations
  - agriculture
  - small catchment dams
- bushfire
- water quality
- land salinisation
- land subsidence
- emerging groundwater technologies.

The following sections describe these risks, the Government's current management actions and what these pressures could mean for future water availability. It is recognised that in addition to these direct pressures on Gippsland's water resources there are external pressures that will also influence the future of the Gippsland Region, including global commodity prices and energy prices.

Population growth

A growing population means that we will require more water for households and industry in the future. The challenge is to ensure sufficient water is available to supply the increasing population in a sustainable way. Total residential demand for water depends on the rate of population growth and the amount of water each person uses.

The Gippsland Region's current population of around 224,000 is expected to increase to approximately 313,000 by 2055. There is a strong population growth predicted in areas of Gippsland close to Melbourne, most notably along the Bass Coast and around Warragul. Strong growth is also predicted in the tourist centres of Bairnsdale and Lakes Entrance. The urban water corporations are implementing a number of actions to ensure existing and future water supplies continue to meet demand. These actions can be found in water corporations' water supply-demand strategies.

Mitchell River (Photographer: DSE)

Water Resource Outlook

Limits to surface water and groundwater allocation

As described in Chapter 2, there are limits to the amount of entitlements that can be issued in surface water and groundwater systems. However in those surface and groundwater systems that are capped, entitlements can be traded between different water users.

The Gippsland Region is one of the few areas in Victoria where there are still some catchments in which new surface water entitlements can be issued within the sustainable diversion limits. The environmental water reserve for these rivers has been established using a precautionary approach by setting a sustainable limit on diversions to ensure the environmental values of the river are protected.

However, in some of the Gippsland Region water systems, the amount of water extracted from rivers is already higher than that which can sustain existing ecological objectives. This has resulted in a decline in the ecological health of these rivers, wetlands, estuaries and aquifers.

In rivers where there is a need for more detailed assessments of the environmental water requirements than the sustainable diversion limits, the FLOWS method is used. The FLOWS method was developed by the Victorian Government and is a nationally recognised 'best practice' environmental flow assessment methodology for determining the flow needs of rivers in water allocation decisions. In the FLOWS method, a team of independent scientists determine the flow components that have a high probability of maintaining key environmental values. These values are identified in each river system by catchment management authorities through the development of regional river health strategies.

FLOWS studies have been completed for the Latrobe, Thomson, Macalister, Avon, Powlett and Tarra rivers in the Gippsland Region, with another underway for the Tarwin River. Estimates of the additional amount of water needed to meet the environmental flow recommendations (the environmental 'shortfalls' determined using the FLOWS method) will be developed as part of the Draft Gippsland Region Sustainable Water Strategy. A separate study is also underway to estimate the environmental water requirements of the Mitchell River during summer.

In addition to establishing the current caps, Victoria has committed to several water saving projects including the Snowy Recovery project and the modernisation of the Macalister Irrigation District that will provide 5,000 ML for environmental use in the Macalister River.

In unregulated systems, the Government aims to provide ecologically sustainable environmental water reserves primarily through managing existing diversions.

While the overall level of environmental 'shortfalls' in the region is low compared to the other parts of Victoria, the region's water resources are likely to be impacted by future drought, climate change and pressure for increased development. It is important that the values and functions of the rivers and associated ecosystems that are currently in good condition are protected.

Health of the Gippsland Lakes

The Gippsland Lakes supports a rich biodiversity and has many environmental values. It is listed as a Wetland of International Significance under the Ramsar Convention and provides significant economic and social benefits to the region and the State. Almost all of the Gippsland Lakes system is an estuarine environment, meaning the ecological functions are controlled by the mixing of seawater and freshwater. The sections of the Lakes near the entrance to the sea are almost marine, while other parts are dominated by freshwater.

Freshwater inflows are delivered to the Gippsland Lakes by seven rivers: Latrobe (including Thomson); Mitchell; Avon; Tambo and Nicholson. The Latrobe and Mitchell rivers provide over three-quarters of the annual inflows. The ecological health of these rivers is critical to ensure the Gippsland Lakes are provided with freshwater inflows with minimal sediment load, and aquatic fauna and flora are able to move freely and colonise in the rivers and lakes. The freshwater and variably saline fringing wetlands appear to be particularly vulnerable to changes in freshwater inflows from the rivers.

It is therefore important that any further water resource development in the Gippsland Lakes catchments appropriately considers the freshwater requirements of the Lakes. A scoping study has been undertaken to investigate the environmental water requirements for the Gippsland Lakes system. The goal of the investigation is to provide decision makers with the ability to relate changes in freshwater inflows to the subsequent environmental consequences in the Lakes. The findings of this study will inform the development of the Draft Gippsland Region Sustainable Water Strategy.

Groundwater / surface water interactions

In Gippsland, groundwater makes a significant contribution to the total streamflow in most rivers and wetlands, while aquifers are also reliant on recharge from streams and wetlands in some areas. Studies for the Avon and Tarra rivers have shown an interaction between groundwater and surface water in these systems. A study investigating surface water and groundwater interaction in the Avon catchment suggested that groundwater pumped from the shallow aquifer would ultimately result in a reduction in streamflow of nearly the same volume.

Declining groundwater levels can reduce flows into rivers and wetland systems where these systems are connected. However, the complex aquifer system in Gippsland makes it difficult to determine the exact relationship between groundwater level decline and changes to surface flow.

Links between surface water and groundwater are managed on a case-by-case basis as interaction varies markedly for different aquifers.

(Photographer: DSE)

Landuse changes

Vegetation Cover

Changes in the extent and type of vegetation cover arising from changes in agricultural practices, bushfires, plantations, timber harvesting regimes and revegetation can all influence water availability. Run-off and groundwater recharge are directly related to the extent and composition of vegetation cover. Typically, trees generate less run-off and less groundwater recharge than cleared areas or annual pastures because they intercept and use more rainfall.

The north and east of the Gippsland Region is predominantly vegetated, with only relatively small pockets of cleared land. Much of this area is covered by the Alpine National Park and various State Forests. Extensive tree cover exists along the Strezelecki Ranges and in the National Park at Wilson's Promontory. West and south Gippsland have largely been cleared for urban, industrial and agricultural development. Run-off in these areas would be expected to be higher now than when the area was covered with native forest.

Changes in vegetation cover can occur in response to changing economic circumstances, the availability of resources including water, or changing demographics. In the Gippsland Region, examples of land use changes that can impact on water resources include the expansion of timber plantations, forestry, changes in agriculture and revegetation for biodiversity benefits or carbon capture. In addition, vegetative cover has been changed by significant bushfire events such as those experienced during the summers of 2003, 2006/07 and 2009.

Land use change can impact on water availability, water quality, carbon storage and biodiversity. Land use change may also impact on the socio-economic factors of a region, including changes in the size of communities, their demographic profile or overall resilience in times of low allocations.

Under Action 2.20 of *Our Water Our Future* and in accordance with requirements of the *National Water Initiative*, work is underway to develop a framework to account for and manage the impacts of land use change on water resources.

While some studies have proposed a link between large-scale vegetation change and changes in climate at a regional scale, the magnitude of the impacts are relatively small even for large-scale vegetation change. In the case of the Gippsland Region, any relationship between vegetation change and climate would be expected to be a relatively minor influence in the context of future land use change given other climatic influences.

Water Resource Outlook

Timber plantations

The establishment of large-scale timber plantations can have significant benefits to a region in addition to providing timber and pulp products, such as helping control dryland salinity, creating habitat (in some cases), greenhouse offsets and biomass for renewable energy.

However, it is well established that the transformation of broadacre grazing to more intensive land uses, particularly forestry, uses more water. Depending on their location, large-scale timber plantations can significantly reduce surface water run-off and groundwater recharge. Consideration of the impact of plantations on the water cycle is included in Action 2.20 of *Our Water Our Future.*

In the Central Gippsland and the East Gippsland-Bombala National Plantation Inventory areas, there is approximately 145,000 hectares of plantations.[18] This represents approximately one third of the total plantation estate in Victoria.

The Government recognises the regional development and potential environmental benefits of plantations, and encourages sustainable private forestry investment throughout Victoria. The Gippsland Region has been identified as one of the areas most likely to experience plantation expansion into the future.

Agriculture

Agriculture is expanding and diversifying throughout the Gippsland Region. Aquaculture, grain production, fodder cropping, poultry and seed production are all growing industries within the region. The organic industry is also rapidly growing in Gippsland and organic dairy, horticulture and beef production are leading this development. New agricultural industries are also being attracted to the area, including nurseries, and hydroponic tomato growing. These industries could look to groundwater to supplement their water needs.

Small catchment dams

Small catchment dams include dams for irrigation and commercial purposes that are subject to licensing and dams for aesthetic or stock and domestic purposes, which are not subject to licensing. In some areas, an increase in the number of these unlicensed dams could have a considerable impact on water resources.

As water availability decreases, it can be expected that the water use of small catchment dams will become an increasingly larger proportion of total consumptive use. This is because farm dams capture run-off before it flows into rivers, which affects all other downstream users and the environment.

While the Government does not intend to prevent the effective watering of stock and access to water for domestic purposes, the Draft Strategy will explore priorities and opportunities to manage the impacts of small catchment dams where localised impacts exist.

Bushfire

The Gippsland Region has been subject to three severe bushfire events in the past decade. Under climate change, it is likely that bushfires will become more frequent, intense and extensive.

Bushfires can have a direct impact on water resources. Water quality is often threatened immediately after a severe fire as rain washes ash, charcoal, nutrients and other materials into rivers and wetlands, causing increased turbidity and changes to local stream ecology. Increases in run-off rates are generally experienced for several years after a fire, due to the reduction in vegetation cover. In the longer term, surface and groundwater levels may be reduced once regenerating vegetation enters a phase of rapid growth. For example, around 20 years after a bushfire, regenerating forests typically use greater amounts of water than the mature forests. Depending on the age of the forest when it was burnt, this can result in reduced inflows to river systems and storages. As forests mature, they gradually use less water than a younger forest.

Much of the fire risk in the Gippsland Region is in the heavily forested areas of the Great Dividing Range where most of the region's larger rivers originate. The 2003 alpine fires burned approximately 1.4 million hectares of largely native forest (spanning both sides of the divide), whilst the 2006/07 alpine fires burned approximately 1.2 million hectares. A small portion of the area burnt in the 2003 fires was also burnt in the 2006/07 fires. There were a number of major fires in the Gippsland Region in the beginning of 2009, including the Bunyip Ridge fire and the Churchill-Jeeralang Fire Complex.

The impacts of bushfires on water quantity will depend on a range of factors including the bushfire history of the area (which affects the type and age of vegetation), and the timing, intensity and spatial extent of any fires. Given the likely increase in bushfire frequency, intensity and extent under climate change, water quantity impacts are difficult to predict. A study into the combined impact of the 2003 and 2006/07 bushfires on streamflow in the Gippsland Region is being undertaken by the Department of Sustainability and Environment. The preliminary estimates from the study assume that no bushfires occur across the study area into the future, in which case:

- an initial increase in streamflow into the Gippsland Lakes of around 45 per cent could be expected assuming average climatic conditions.
- the largest reductions in streamflow could be expected to occur approximately 20-30 years post-fire, with the estimate of reduction of streamflows in catchments flowing into the Gippsland Lakes (assuming average climatic conditions) of approximately 255 GL per year (which is equivalent to -8 per cent of the mean annual inflow to the Gippsland Lakes).

Of those rivers in the region affected by the 2006/07 fire, the preliminary estimates indicate that the Nicholson River may have the largest percentage reduction in mean annual flow of 12 per cent (or six GL) around the year 2020. If dry conditions persist, it would be expected that the volumetric impacts would be smaller than the preliminary estimates presented above.

Water quality

There are a range of risks posed to surface water and groundwater quality across the Gippsland Region. For example, intensive extraction from the Boisdale aquifer in the Clydebank area has led to a risk of saline groundwater intrusion from Lake Wellington. A management zone has been set up in this area to protect against this risk.

Seawater intrusion into the groundwater system is also a risk in the Yarram area and along the coast where groundwater levels onshore are falling to near sea level.

For estuarine river reaches, rising sea levels and reduced freshwater inflows may result in these environments becoming more marine, rather than estuarine. Seawater may also travel further up rivers, having an effect on fish breeding and habitat availability, distributions and health of aquatic and semi-aquatic plants and other ecological processes.

Nutrient run-off into the waterways that feed the Gippsland Lakes has contributed to frequent algal blooms in the Lakes. Since 1995 there have been four major bloom events of the toxic *Nodularia spumigena*. More recently a major bloom of *Synechococcus* was widespread across the Gippsland Lakes during the summer months of 2007/08.

Potato Farm, Thorpdale (Photographer: VFF)

Land salinisation

The application of water for irrigation has caused land salinisation in parts of Gippsland (Nambrok Denison, Macalister). Land salinisation reduces the productivity of the land and also contributes to increased salinity in run-off which can affect waterways. There are extensive salinity management plans in place to address land salinisation. There is a need to ensure in any planning process that the needs of managing land salinisation and groundwater and surface water resources are integrated.

Land subsidence

Land subsidence due to groundwater extraction has been identified as a potential issue in the Gippsland Region. When the pressure in an aquifer reduces as a result of water extraction, the overlying earth can compact and sink. This is already occurring around the coal mines in the Latrobe Valley. The possibility that continuing water level declines in the Latrobe Aquifer could cause the coastal area to subside has been a concern since the 1990s. More recent studies suggest that coastal subsidence is less likely than first anticipated, and that the subsidence risks from groundwater level decline on the coast are small relative to the greater risks from climate change to sea level rise and storm surge intensity. However, potential impacts of groundwater pumping on land subsidence need to be considered as part of any resource management strategy.

Emerging groundwater technologies

There are increasing pressures on the groundwater resource in the Gippsland Region, in terms of both water availability and aquifer condition. A range of new technologies that have the potential to impact on groundwater systems are summarised below, while Chapter 4 discusses the opportunities to manage these technologies within the water entitlement framework.

Groundwater desalination

The use of small-scale *in situ* groundwater desalination technologies is emerging across Victoria in response to drying conditions. The *in situ* desalination process occurs within bores, where it removes salt to increase the potential uses of the water. The salt is then re-injected into the aquifer.

Geothermal energy

The Victorian Government has awarded five permits for geothermal exploration in areas across the Gippsland Region. There are two forms of regulated geothermal energy relevant to Gippsland:

1. Hydrothermal energy involves extracting naturally heated water from deep in the ground, typically three to five kilometres. Once the water is brought to the surface, energy is extracted and the water is returned to the aquifer or discharged to a waterway.

2. Hot dry rock geothermal energy derives energy from the heat stored within the rock itself, typically at depths of three to five kilometres. Water (or another fluid) is injected into the artificially fractured hot rock through an injection well and once heated it is brought back to the surface where the heat is extracted. The water is then re-circulated through the injection well.

Both technologies have the potential to affect the groundwater levels and quality within the aquifer, as well as surrounding aquifers. The impact of exploration activities on aquifers is significantly less than the impact of development activities.

Carbon capture and storage

Carbon capture and storage (CCS) involves the capture of carbon dioxide from industrial emissions and injecting it under pressure into rock formations that can naturally store it. This technology is likely to be implemented in the Gippsland Region, as it could be used to remove carbon from various industrial processes in the Latrobe Valley. The potential for this technology (both onshore and offshore) to impact on aquifer pressures and quality needs to be considered.

Underground coal gasification/liquification

Underground coal gasification/liquification involves turning coal into hydrocarbons in the coal bed by *in situ* processing, in order to produce commercial quantities of gas or oil. This technology is at an early developmental stage internationally and could one day be considered for use in the Gippsland Basin, where it could be applied to deeper coal seams that cannot be mined commercially. These coal seams could be part of, or occur above or below aquifers used for water resources. Underground coal gasification/liquification could have a direct impact on aquifers in the Gippsland Region through additional demand for water, or the creation of by-products that could pollute groundwater resources.

Coal seam methane

Coal seam methane is the extraction of methane gas from deeper coal seams that cannot be mined commercially. The process of extracting coal seam methane involves extraction of water. Commercial coal seam methane production requires that the coal seam is not an aquifer and that it has poor connection with any nearby aquifers to successfully depressurize the coal seam and release the methane. Since 2005 coal seam methane has been trialed near Longford in the Yarram Water Supply Protection Area. There may be the potential to apply coal seam methane commercially in the Gippsland Region. Apart from extraction of groundwater, it could impact directly on aquifers by affecting water levels, water quality and aquifer properties.

Primary commodities derivatives from brown coal

There are a range of primary commodities derivatives that can be derived from coal, including methanol, ammonia and oil (from coal-to-liquids technology). The extraction of coal for the production of these products has the potential to impact on groundwater systems.

Managed Aquifer Recharge

Managed Aquifer Recharge (MAR) is a water management strategy involving the capture of water run-off for storage in aquifers as a means of minimising the impact of drought. MAR will potentially be considered throughout the state including the Gippsland Region and is considered to be technically feasible. There are national guidelines on MAR and the Environment Protection Authority (EPA) is releasing specific guidelines for Victoria in the near future. MAR can alter the water quality and levels locally within aquifers. Consideration would need to be given as to how MAR would be managed from a resource allocation perspective.

Forecasting future water availability

Models are used to project data into the future, to predict how potential impacts, such as climate change may affect future water supplies.

These models of what the future might look like allow us to consider different scenarios. For example, they have been used to translate estimates made by the CSIRO in 2005[19] of the potential impacts of low, medium and high climate change on streamflows into potential impacts on water flowing into river systems and storages. The further into the future we look, the more uncertain our forecasts become.

This Strategy is the first time that estimates of the impact of climate change on future water availability have been integrated across systems throughout the Gippsland Region. The second phase of the South Eastern Australian Climate Initiative is likely to improve the scientific understanding around climate projections for South East Australia. The forecast impacts of low, medium and high climate change on streamflows will continue to be updated as the scientific understanding improves. While the magnitude of more recent estimates are expected to be broadly similar to existing estimates, these adjustments will help to refine the modelling results.

Modelling of our water resources since the 1970s has increased our understanding of reliability of supply. The results of this modelling provide key information about the water availability and reliability of supply associated with the historic record of inflows (long-term average inflows). It is the baseline against which future scenarios are compared.

The following modelling scenarios[20] have been used:

- Base case – long-term average, based on the historic record. The length of record varies for each system according to the data that is available.
- Scenario A – based on the CSIRO low climate change predictions.
- Scenario B – based on the CSIRO medium climate change predictions.
- Scenario C – based on the CSIRO high climate change predictions.
- Scenario D – based on a continuation of the low inflows of the past 12 years (ie. average reduction in streamflows over the past 12 years).

This Discussion Paper examines two scenarios in detail, Scenario B and Scenario D. Scenario D allows us to develop a good understanding of the impacts of the past 12 years and be prepared for the possibility that these low inflows may continue. Planning for the continuing low inflows scenario, whilst severe, is less risky than assuming inflows will soon return to the historic average conditions. However, given that the continuing low inflows may or may not eventuate, it is also prudent to look at the impacts of an intermediate scenario (Scenario B) and compare these with the historical situation (base case).
In this way, the community's decisions can be based on a good understanding of a range of possible water futures – allowing timely action in preparation for the continuing low inflows scenario without causing unnecessary pain or investment should this not eventuate.

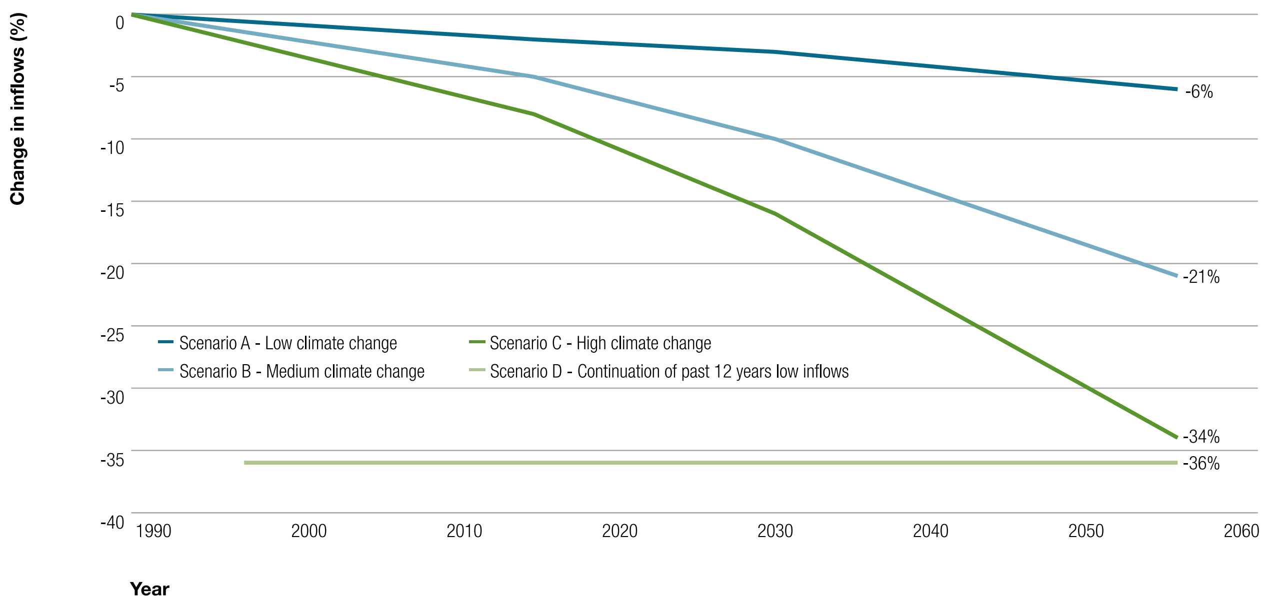
The modelling scenarios used here highlight the uncertainty in forecasting the extent and timing of changes to water availability as a result of climate change. There may be a gradual reduction in water availability over time, resulting in modest or substantial change in 50 years. Alternatively, the extreme conditions experienced over the past 12 years could continue for some time or even deteriorate further.

In light of this uncertainty, the Gippsland Region Sustainable Water Strategy aims to provide current information on a range of scenarios to individuals, the Government, industries and communities to support long-term planning and decision-making. This kind of planning is difficult and confronting, but it is important that we start to think about the implications of increasing water scarcity so that we can be prepared.

The forecasts in this chapter show it is likely there will be less water available in the future and this will affect consumptive use and the environment. Climate change is likely to be the most significant of several factors contributing to these reductions.

By 2055, water availability in the Mitchell system could be reduced by six per cent under a low climate change scenario, or as much as 34 per cent under a high climate change scenario compared to the long-term average (see Figure 3.4). If the past 12 years of low inflows continued, it would equal an immediate reduction of 36 per cent compared to the long-term average. Scenarios shown in Figure 3.4 only present the climate change impact on streamflow resulting from changes in rainfall. Some of the other risks to water availability presented in this chapter will be additional to the impacts of climate change.

Figure 3.4 - Scenarios A to D – Potential reduction in total inflows for the Mitchell system over 50 years (compared to the long-term average)



Water Resource Outlook

Table 3.1 shows the expected reduction in total inflows for each of the major river systems in the Gippsland Region as a result of climate change. For five of the river systems the reduction in inflows over the past 12 years is generally similar to the expected impact in 2055 for a high climate change scenario while impacts for the remaining three systems (East Gippsland, Snowy and South Gippsland) are higher than expected under a high climate change scenario.

Table 3.2 and Table 3.3 summarise the potential impact of Scenarios B and D on water availability for the major regulated river systems in the Gippsland Region. They show the impacts of the climate change scenarios on total inflows and the differing impacts on consumptive use and the environment.

Tables 3.2 and 3.3 show that in future we can expect a reduction in water available for environmental needs as well as consumptive purposes as a result of climate change. For example, in the Latrobe system it is estimated that under a continuation of low inflows (see Table 3.3), inflows would be about 300 GL lower on average each year, about 250 GL less water would be available for environmental needs, and available water for consumptive users (urban and irrigation) would reduced by about 30 GL. This assumes that no action is taken to respond to these reductions.

Tables 3.2 and 3.3 also show that the reduction is not borne in equal proportions between users. Most often it is the environment that takes on the greatest reduction, as shown graphically for the Latrobe system in Figure 3.5.

Mitchell River (Photographer: DSE)

Table 3.1 - Scenarios A to D – Potential reduction in total inflows for river systems in the Gippsland Region as a result of climate change (compared to the long-term average)

System	Inflow impact in 2055 under each CSIRO climate change scenario			D – Impact experienced over past 12 years[a]
	A – Low	B – Medium	C – High	
East Gippsland[b]	-2%	-5%	-18%	-33%
Snowy[c]	-4%	-12%	-26%	-55%
Tambo	-5%	-19%	-35%	-44%
Mitchell	-6%	-21%	-34%	-36%
Avon	-7%	-23%	-40%	-55%
Thomson	-7%	-23%	-40%	-43%
Macalister	-7%	-23%	-40%	-40%
Latrobe	-7%	-19%	-35%	-43%
South Gippsland[d]	-7%	-17%	-28%	-41%

Notes:
a Reduction of average annual inflows when comparing pre July 1997 average inflows to post July 1997 inflows
b Scenario D for Bemm, Betka and Cann Rivers only (calculated from resource allocation modelling)
c Scenario D calculated from gauged data at Jarrahmond (gauge 222200)
d Scenario D for Bass, Powlett, Tarwin, Agnes and Tarra systems only. Data sourced from resource allocation modelling.

Table 3.2 - Scenario B (at 2055)[a] – for total inflows, consumptive use and environmental flows (GL/yr)

Expected impacts in 2055 – CSIRO medium climate change	River systems Thomson	Macalister	Latrobe[c]	Mitchell	South Gippsland	East Gippsland
Total inflows[b]						
Long-term average	366	496	847	884	911	714
Medium climate change	281	382	686	698	756	678
Difference (%)	-85 (-23%)	-114 (-23%)	-161 (-19%)	-186 (-21%)	-155 (-17%)	-36 (-5%)
Diversions for consumptive use						
Long-term average	203	209	228	24	85	19
Medium climate change	168	201	206	24	80	19
Difference (%)	-35 (-17%)	-8 (-4%)	-22 (-10%)	0 (0%)	-5 (-6%)	0 (0%)
Environmental flows						
Long-term average	138	280	610	860	837	695
Medium climate change	94	173	472	674	676	659
Difference (%)	-44 (-32%)	-107 (-38%)	-138 (-23%)	-186 (-21%)	-161 (-19%)	-36 (-5%)

Notes:
a Forecast reduction in water availability in 2055 under medium climate change scenario (compared to the long-term average)
b The diversions for consumptive use and environmental flows will not be equal to the total inflows. The difference represents the average volume of unaccounted water including losses and/or the difference in stored water at the beginning and end of the period examined.
c Figures for Latrobe system long-term average differ slightly from those in Table 2.1 due to influence of industrial wastewater discharges.

Table 3.3 - Scenario D (impact from now) – for total inflows, consumptive use and environmental flows (GL/yr)

Immediate impacts of continuation of past 12 years low inflows[a]	River systems Thomson	Macalister	Latrobe[b]	Mitchell	South Gippsland	East Gippsland
Total inflows[c]						
Long-term average	366	496	847	884	911	714
Past 12 years average	235	345	546	610	545	420
Difference (%)[a]	-131 (-36%)	-151 (-30%)	-301 (-36%)	-274 (-31%)	-366 (-40%)	-294 (-41%)
Diversions for consumptive use						
Long-term average	203	209	228	24	85	19
Past 12 years average	152	199	201	23	79	19
Difference (%)	-51 (-25%)	-10 (-5%)	-27 (-12%)	-1 (-4%)	-6 (-7%)	0 (0%)
Environmental flows						
Long-term average	138	280	610	860	837	695
Past 12 years average	67	146	336	587	477	401
Difference (%)	-71 (-51%)	-134 (-48%)	-247 (-45%)	-273 (-32%)	-360 (-43%)	-294 (-42%)

Notes:
a This table shows the reduction in inflows over the past 12 years compared to the long-term average (i.e. the full historic record). This allows comparison with the medium climate change scenario shown previously in Table 3.2. It should be noted that the percentage reduction shown here will not be the same as those in Table 3.1. This is because Table 3.1 Scenario D column figures are calculated by comparing pre 1997 data to post 1997 data.
b Figures for Latrobe system long-term average differ slightly from those in Table 2.1 due to influence of industrial wastewater discharges.
c The diversions for consumptive use and environmental flows will not be equal to the total inflows. The difference represents the average volume of unaccounted water including losses and/or the difference in stored water at the beginning and end of the period examined.

Water Resource Outlook

Figure 3.5 - Relative shares of resource for the Latrobe system under the long-term average, Scenario B and Scenario D.

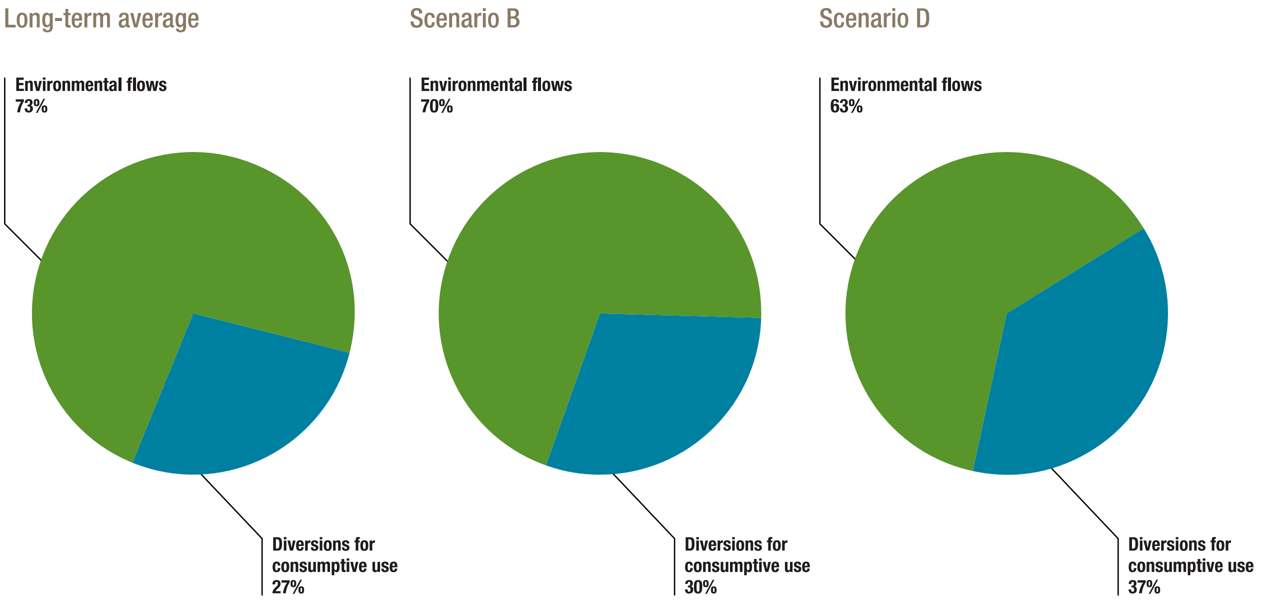


Figure 3.6 and Figure 3.7 summarises the typical impact of Scenario D on water availability for irrigation. The figures demonstrate that in future, on average and without action, allocations will be lower than historically experienced.

Climate change will also impact on some components of the EWR. The effect of climate change on estuary systems in the Gippsland Region could be significant. In the case of the Gippsland Lakes, a scenario whereby the climate of the last 12 years continues into the future would result in a reduction of inflows by over 30 per cent to the Lakes. Under a low climate change scenario, inflows may only be reduced by seven per cent. As well as reduced inflows, the prediction of sea level rise may lead to a general rise in lake levels of 0.3 to 0.6 metres by 2100. The combined effect of severely reduced freshwater inflows and rising sea levels would likely move the system to predominately marine conditions with only periodic influxes of freshwater during floods. Climate change therefore has the potential to exert an overwhelming influence on the future state of the Gippsland Lakes system. This could have very significant ramifications for many of the important values of the Lakes systems, including its Ramsar values.

Understanding the impact of climate change or a continuation of recent low rainfall on groundwater resources cannot be assessed in the same way we assess surface water. This is because there are many factors that influence how water is recharged to groundwater aquifers.

The volume of water entering aquifers through soil, riverbeds or wetlands is called recharge. Changes in temperature, evaporation and rainfall all affect the way water moves through the soil to the water table.
In addition, a changing climate can vary the amount of water used by plants, change land use (adapting to a drier climate), change patterns of flooding and alter irrigation supplies and application rates. These all affect the available moisture in the ground, and consequently affect the volume of water available for recharge. Studies undertaken elsewhere in Victoria suggest that for every one per cent reduction in rainfall, there is a two to four per cent reduction in recharge.

The most at risk aquifer systems from climate change are unconfined aquifers, particularly those with shallow watertables. These groundwater systems are most likely to respond rapidly to climate change, as they do to droughts and floods. Larger, confined systems will take longer to respond.

The greatest uncertainty in how significant these impacts will be is trying to predict what a changed climate will look like. As it will be difficult to predict what may happen, it is important that management of groundwater resources consider climate variability in determining permissible consumptive volumes and be supported by a management framework that allows adaptation to changed climate conditions.

Figure 3.6 – Typical impact of climate change (Scenario D) on water allocation (Mitchell River example)

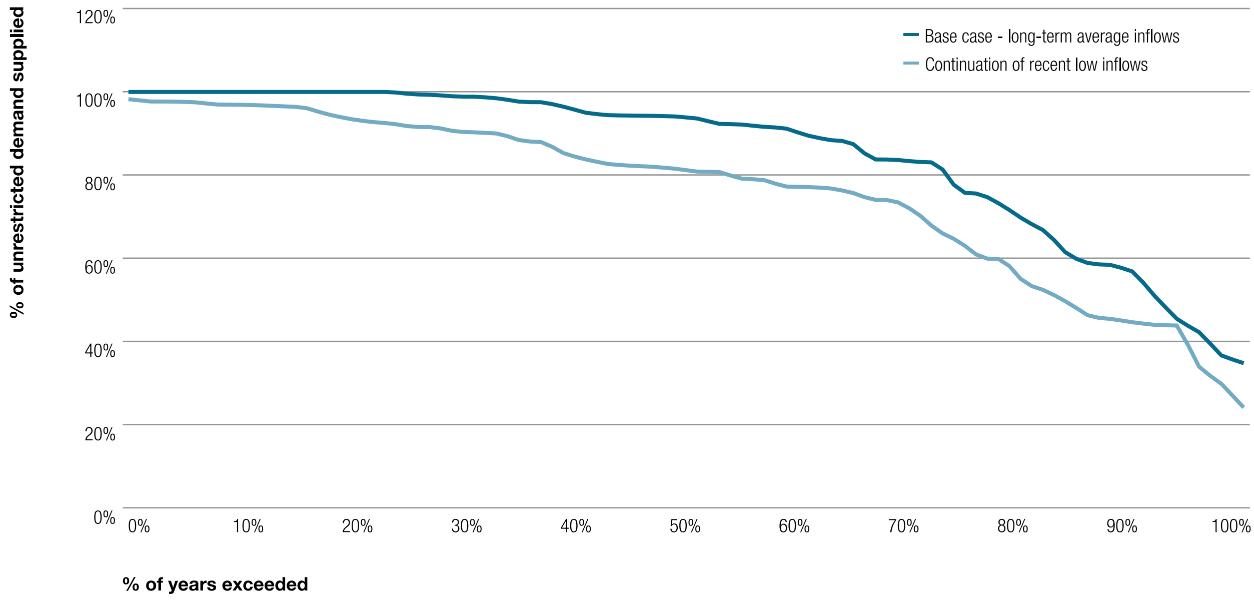
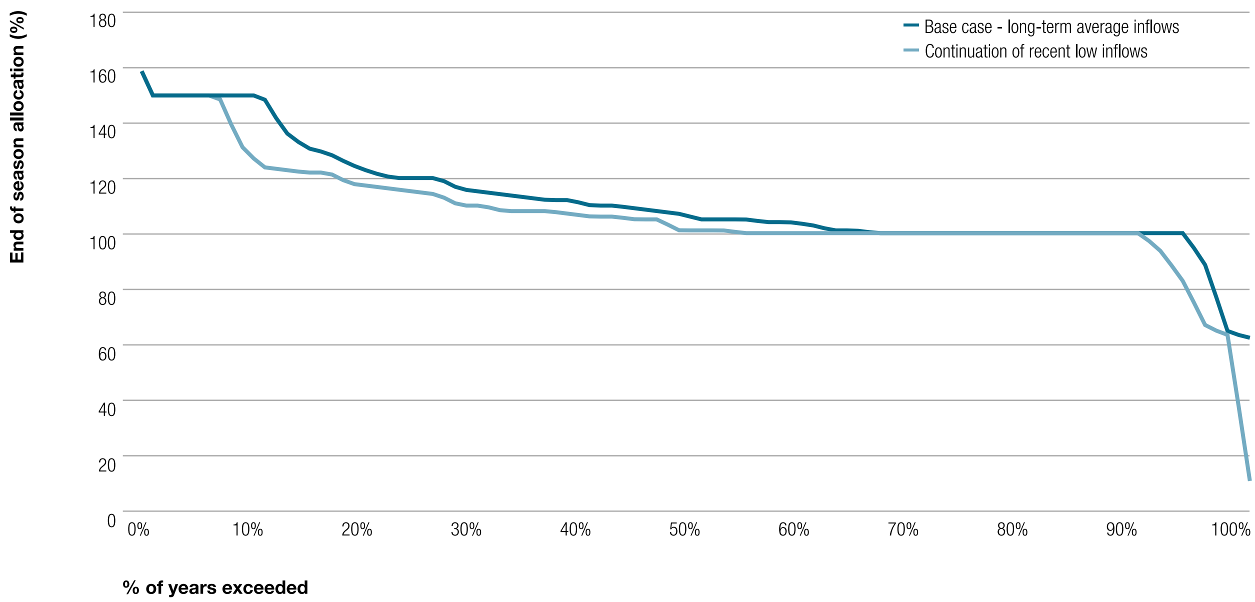


Figure 3.7 – Typical impact of climate change (Scenario D) on water allocation (example from Macalister Irrigation District)



Adapting to change over the next 50 years

This chapter aims to encourage discussion on opportunities and proposals for the Gippsland Region's water resources, with a view to securing the region's water future. The previous chapter outlined impacts and implications of future water availability scenarios on rural and urban users, industry and the environment. Regardless of the scenario considered, it is likely that the community will need to adapt to increasing water scarcity.

A range of potential water resource management opportunities for the Gippsland Region over the next 50 years are presented in this chapter. In the development of the Gippsland Region Sustainable Water Strategy, the economic, environmental and social benefits and costs of the responses will be considered. The Draft Strategy will include an analysis of each of the potential opportunities, along with any additional opportunities that are identified in your submissions to this Discussion Paper.

While the Gippsland Region has more water resources than much of the State, the community and the environment will need to continue to adapt to increasing water scarcity in light of the potential impacts of climate change and land use change, combined with the challenges of population growth. The Strategy provides the community and the Government with an opportunity to work together to plan the best way forward to sustainably manage the region's water resources over the next 50 years. This Discussion Paper is the first step in the development of the Strategy.

Deciding how to manage the Gippsland Region's water resources requires broad thinking about what the region will look like over the next 50 years. For instance, some preliminary work prepared by the Gippsland Local Government Network identified the region as a potential 'food hub' and an important tourism destination.[21]

Questions to consider when making a submission:

What should the Gippsland Region look like over the next 50 years and how can water policy help to achieve this?

What will water be used for in the Gippsland Region?

Considering the likely risks and pressures on our water resources discussed in Chapter 3, how should we best prepare for a future with reduced water availability?

Toorongo Falls (Photographer: DSE)

A range of responses to managing water scarcity

The responses identified in this chapter concentrate on the regional opportunities for managing water scarcity. The potential responses build on existing drought response planning, water supply demand strategies, regional river health strategies and the state-wide projects announced through *Our Water Our Future and Our Water Our Future - the Next Stage of the Government's Water Plan.*

The responses fall into five broad categories:

- opportunities to save water: including additional improvements to irrigation efficiency in the Macalister Irrigation District and ways to reduce water consumption
- opportunities with available water: including storage, recycling, unallocated water and supply augmentations
- opportunities to move water: including opportunities to expand the water grid and develop connections to improve the flexibility of the region's water supplies
- opportunities to improve and maintain environmental values in the face of climate change and other pressures
- state-wide opportunities to improve the management of Victoria's water resources.

Although there are numerous cross-basin connections in the Gippsland Region, there are still many supply systems that have no connections to supply systems outside their local area. This lack of connection can expose the supply systems to a greater risk of water restrictions or even supply failures during drought or times of poor source water quality. In addition, many water supply systems across the Gippsland Region have a relatively small storage capacity. Opportunities to increase the security of supply systems include increases in storage capacity and improved interconnection between supply systems.

Many improvements have been made to the efficient use of water resources in the Gippsland Region, such as increasing the efficiency of irrigation channels in the Macalister Irrigation District and recycling wastewater by construction of the Gippsland Water Factory. Opportunities for additional efficiency improvements and using alternative water resources, such as recycling, are presented in this chapter.

Maintaining and improving water-dependent environmental values across the Gippsland Region, such as the Gippsland Lakes and other estuarine systems, is likely to become increasingly difficult as a result of climate change and other pressures. This chapter presents the opportunities that have been identified to maintain and improve environmental values.

Submissions are invited on the discussions presented in this chapter. We are also seeking your responses to any other issues and opportunities which should be considered (see Chapter 5 for details on how to make a submission).

Opportunities to save water

Opportunities exist across the Gippsland Region to increase the efficient use of water resources by all users: urban, industry, agriculture and the environment.

Opportunities to improve irrigation efficiency in the Macalister Irrigation District

The Macalister Irrigation District (MID) is the site of the Macalister Channel Automation Project. The project involves channel automation of the MID in six stages to provide up to 15 GL of increased environmental water allocation to the Macalister and Thomson Rivers. The Victorian Water Trust provided funding of $8 million for Stages 1 and 2 and $20 million was funded by the National Water Commission for Stages 3 to 6. Stages 1 to 5 have been completed, and Stage 6 is nearing completion. In June 2008, Southern Rural Water commenced the release of 3 GL savings for environmental flows in the Macalister River, ahead of the formal establishment of the environmental entitlement.

In September 2007 the Southern Rural Water Board released the MID2030 Strategy, which if implemented would complement the Macalister Channel Automation Project. The MID2030 Strategy proposes to increase the water efficiency in the district to 85 per cent through upgrading supply systems and drain systems and advancing irrigation practices.

Environmental benefits from the MID2030 Strategy would include reductions in the amount of nutrients that outfall from the MID to downstream waterways and the Gippsland Lakes.

The implementation of the MID2030 Strategy could begin immediately but it would take over a decade for all projects in the Strategy to be completed.

Questions:

Who should bear the cost of implementing the MID2030 Strategy?

What should happen to the water saved through the MID2030 Strategy?

Adapting to change over the next 50 years

Urban and industrial demand management

There are a range of programs aimed at increasing water efficiency across the urban sector. As discussed in Chapter 1, water corporations are required to prepare water supply demand strategies that identify measures to maintain a balance between demand and supply with a 50 year outlook. The strategies include water recycling and conservation targets.

Initiatives aimed at encouraging greater water efficiency include the WaterSmart Gardens and Homes Rebate Scheme that encourages residential urban water customers to implement more sustainable water use practices. As at April 2009, more than 5,800 rebates have been approved in the Gippsland Region. Water corporations also run a range of programs, such as showerhead exchanges and garden advice, to support their residential customers to use water efficiently.

Knowing how much water is being used in real-time may benefit households trying to save water. Currently, water meters are read manually and water bills provide information on water use up to three months after the water has been consumed. Smart water meters can provide customers with real-time information which could have a range of benefits. The Department of Sustainability and Environment is currently conducting a cost-benefit analysis of smart water meters in the residential sector.

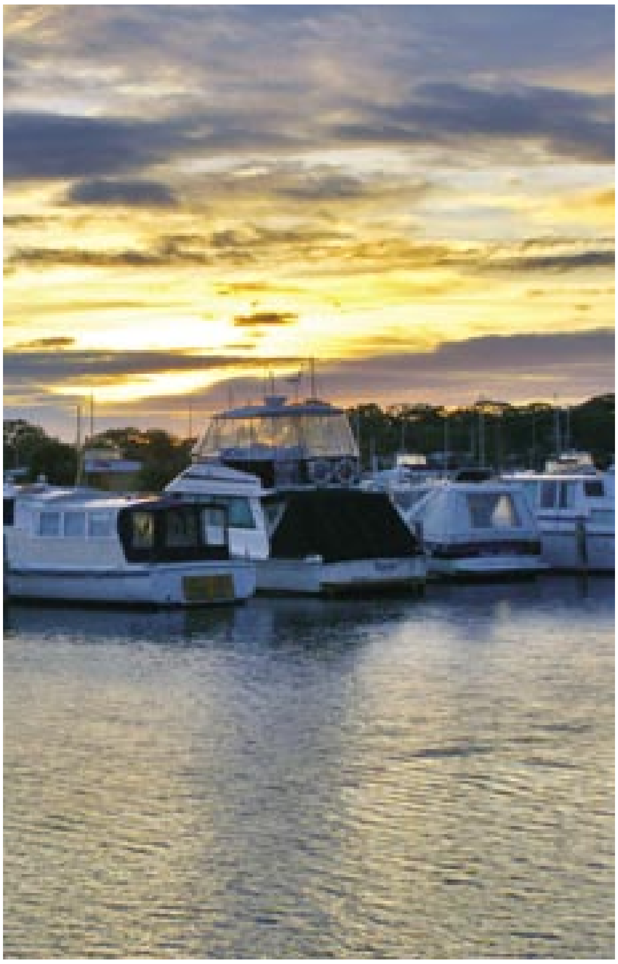
As discussed in Chapter 2, the Latrobe Valley is home to large-scale power generation and paper production, which both use large quantities of water. While significant steps to use water efficiently have already been taken by these industries, any additional water efficiency measures such as dry cooling may have significant benefits for water resource availability. It is important that efficiency measures are encouraged in cases where they are economically feasible and provide broader community benefits.

There are a range of state-wide programs aimed at improving efficient water use by businesses. For example, the Water Management Action Plan (waterMAP) program requires every business using more than 10 ML of potable water per annum to prepare and implement a waterMAP. The Gippsland Region has approximately 80 businesses in this category.

Water corporations also have the ability to apply water restrictions under extreme events. However, restrictions impose costs on the community and should be applied infrequently as a short term management tool with demonstrable efficiencies, and not replace investment in options to balance future supply and demand.

Question:

What urban and industrial water conservation opportunities and barriers exist across the Gippsland Region?



Paynesville (Photographer: DSE)

Opportunities with available water

Alternative sources of water – reusing, recycling, urban stormwater

Opportunities exist across the Gippsland Region to reuse and recycle water, which can help to reduce the reliance on surface and groundwater. Sources of wastewater that can be treated and reused include water from urban water treatment plants, irrigation drainage and industrial discharges for 'fit for purpose' use. Many recycling projects have already been undertaken across the region, with treated wastewater used for irrigation, industry or environmental purposes. Information on recycled water availability and use is presented in Chapter 2.

New opportunities on how to use recycled water may include using it in different ways, or capturing increases in wastewater as the population in the region grows - the volume of wastewater generated is typically around 20 to 40 per cent of the increase in water supplied to consumers.

Recycling and reuse opportunities also have the potential to assist in helping secure the region's water resource for consumptive users and the environment. As technology improves, water reuse and recycling schemes will increasingly become a viable alternative to traditional water sources. The associated expense of water reuse and recycling schemes is likely to continue to be relatively high due to the energy costs of water treatment and providing pipelines for the water to be transported to where it can be used, however the value of traditional sources of water is likely to increase with reduced availability. The relative costs of different supply options are therefore likely to change over time.

There are many local recycling opportunities across the Gippsland Region, such as the construction of dual pipe networks in new residential developments. In addition to the many local recycling opportunities, there may be larger scale recycling projects. However some large projects have proved too expensive to proceed with at present. This was recently shown for the business case for two large-scale recycled water projects linked to the Eastern Treatment Plant.

In addition to the recycling and reuse opportunities, there may also be opportunities to improve the use and quality of urban stormwater across the Gippsland Region.

Questions:

A 50 year outlook needs to be considered in weighing up the relatively high costs of recycling schemes against the likely reduction in water availability from traditional sources of supply. In this context;

- What are the alternative supply and recycling options that should be considered?
- Under what circumstances should recycling schemes be supported in the future if the costs associated with the schemes are higher than the costs associated with existing supplies?

Augmentation – Desalination

The ongoing drought conditions further emphasise the danger of relying solely on dams and why it is vital to diversify our water sources. To this end, the Government has committed to building Australia's largest desalination plant within the region. This initiative forms part of the *Our Water Our Future – the Next Stage of the Government's Water Plan* and is one of a suite of initiatives to develop water sources for the State.

The location for the plant was chosen following an extensive feasibility study which looked at a range of potential sites. The site near Wonthaggi offered the best mix of features needed to build a desalination plant, taking into account environmental, economic and social factors. In particular, the region was favoured because water is drawn from the open ocean which provides the most suitable water quality for the treatment process. It can also be linked to existing water distribution infrastructure.

Following preparation of an Environment Effects Statement and community consultation in 2008, and subject to completion of the tender process for the project in 2009, construction of the plant is scheduled to commence this year in order to deliver water by the end of 2011. The plant will be constructed and operated through a Public Private Partnership. Greenhouse emissions from the plant will be offset by the purchase of renewable energy credits.

The plant will deliver up to 150 GL of water a year without relying on rainfall into our catchments. The plant will provide additional water to Melbourne, and via new connections, to Geelong and to Westernport and South Gippsland. There is potential for an upgrade to provide 200 GL in the future. Given the plant's location within the region, there may also be opportunities for the Gippsland Region to take advantage of this new resource.

Are there any additional regional opportunities to connect to this new source of supply?

Augmentation – New dams

Adapting to change over the next 50 years

Sourcing water from rivers and streams through the construction of large dams on rivers was common practice during the development of Australia over the past 200 years. However, surface water resources are limited and are likely to be further limited as a result of climate change. As the recent dry climate in Victoria has shown, new dams are not the solution to securing our future water needs. They simply take the water from somewhere else – either from irrigators who currently rely on it or from the environment and do not guarantee water availability.

The Government does not support building large dams on rivers in Victoria because they do not create new water and come at great financial, environmental and social cost. Dams are entirely dependent upon rainfall, are at risk from climate change and divert water away from downstream users and the environment.

There have been calls to build new large dams in the Gippsland Region to supply Melbourne, such as on the Mitchell River, the largest of the remaining free flowing rivers in Victoria. Building a dam on the Mitchell River would cause the loss of one of Victoria's last largely untouched river systems, may inundate some local communities and come at a large social and environmental cost. Any new dam on the Mitchell River would also reduce the inflow to the Gippsland Lakes, which would harm the habitat of native plants, fish and animals and threaten waterways, tourism and the recreation industry. This was supported in the study conducted in 2005 on *Alternative Options to Meet Long Term Demands – Dams*[22] which examined the financial, social and environmental impacts of a number of proposed new dams including a dam on the Mitchell River.

In the 2006 sustainability action statement *Our Environment Our Future* the Government committed to extending the *Heritage Rivers Act 1992* to include protection of the Mitchell River. The inclusion of the Mitchell River in the *Heritage Rivers Act* prohibits any new impoundments on the Mitchell River.

Several other proposals to divert the Gippsland Region's rivers for supply to Melbourne have been suggested in the media recently, including a new dam on the Macalister River upstream of Lake Glenmaggie and a diversion weir on the Aberfeldy River (a tributary of the Thomson River). These rivers are highly developed for irrigation and urban water supplies and already harvest the most reliable river flows. On this basis, the proposals could not reliably provide the volume of water required to justify the cost of the works.

There have also been calls to build dams in the Gippsland Region for flood mitigation and for local uses including irrigation on the Lindenow Flats, and to modify existing storages to increase capacity. When assessing these options, it is necessary to consider the impacts such modifications may have on other users. For example, modifications are likely to result in a reduction in winter spills in some storages, which potentially may have a negative impact upon the environment and other downstream users.

Question:

Government has a clear commitment not to build any new dams on Victorian rivers due to the significant economic, social and environmental costs of new dams, and the likelihood of reduced reliability of supply due to climate change. If off-stream water storages are built to provide water for commercial operations, who should bear the financial cost?

Unallocated share of Blue Rock Reservoir

As the second largest water storage in the Gippsland Region and the principal water storage in the Latrobe Valley, Blue Rock Reservoir is fundamental to the reliability of water supply in the region. With a total capacity of 208 GL, the storage volume was 154 GL at the end of April 2009. Blue Rock Reservoir is rapidly becoming more valuable in the context of persistent drought and the climate change scenarios outlined in Chapter 3.

The Reservoir is used primarily to provide reliable water supply to industrial users in the Latrobe Valley. In particular, it is the main source of regulated water for the brown coal-fired power generators located in the Latrobe Valley. The water currently allocated is shared between the power generators, Gippsland Water and Southern Rural Water. The shares of allocated inflows and storage capacity, for Blue Rock Reservoir, are shown in Table 4.1. The Government acknowledges that it is critical to ensure there is sufficient access to water via the market to maintain generating capacity for the power industry.

In addition to the water allocated to power generators, Gippsland Water and Southern Rural Water, there is a share of 10 per cent held by Government on behalf of the former State Electricity Commission of Victoria (SECV), and in addition an unallocated portion that corresponds to a share of 35.6 per cent.

The 10 per cent share held by the Government is the portion of the former SECV share that remained with Government when the SECV was disaggregated in 1995 and is for future power industry needs. Since 1995 the Government has on occasions made water held in the SECV share temporarily available to Latrobe entitlement holders to overcome water shortages.

The unallocated portion of Blue Rock Reservoir corresponds to a share of 35.6 per cent of inflows and storage space in the Reservoir. Depending on the assumptions around how the share is used, the modelled annual yield would be about 26 GL per year based on long term climate records, or about 19 GL per year under continuing dry conditions. The Victorian Government is responsible for the allocation of this water.

TABLE 4.1 - Allocated shares of Blue Rock Reservoir

User	% allocated
Yallourn	14.97
Loy Yang A	16.4
Loy Yang B	8.2
Gippsland Water	12.4
SECV	10.43
Southern Rural Water	2
Total	**64.4 (leaving 35.6% unallocated)**

The Central Region Sustainable Water Strategy announced initiatives to increase environmental flows in the Latrobe River by an additional 10 GL for seven years through a temporary transfer of some of the unallocated share in Blue Rock Reservoir. The allocation is to be accompanied with a study on the use of the additional water to determine the most effective method to meet its river health objectives. In the meantime, the unallocated water has improved the reliability of water for existing users.

Given the strategic importance of the Reservoir, there is a need to determine how the unallocated portion Blue Rock Reservoir will be managed in the future. Establishing a process to determine how to allocate this water will go some way to providing entitlement holders and water managers with the certainty they require to plan for the future. The process will be mindful of previous commitments made in *Our Water Our Future* which states that for any significant new water allocations for consumptive use, the Government will establish an auction or tender process that allocates water resources by public advertisement of the sale and setting of a reserve price.

Possible uses for the unallocated water include:

- a drought reserve
- improving the reliability of existing Blue Rock Reservoir entitlement holders
- new industries
- improving environmental values
- improving recreational opportunities in Lake Narracan.

Question:

What uses should be considered for the unallocated portion of Blue Rock Reservoir?

Mitchell River (Photographer: DSE)

Adapting to change over the next 50 years

Opportunities to improve the allocation of surface and groundwater entitlements

Surface and groundwater resources are limited. If there were no regulations to limit access and use of water resources, ever increasing levels of use would impact on water availability for existing users and result in the loss of environmental values on which the community depends. The Government requires most users to hold a licence, water share or bulk entitlement, which protects existing users as well as environmental values. In allocating water the Government needs to make decisions on what is an acceptable level of risk to existing water users and the environment, informed by the information that is available for the water resource.

Assessing applications for new water licences or applications to trade water licences

Community complaints around access to water resources typically fall into two categories:

1. those that want an entitlement but have been refused
2. those who have had their water access reduced because of a new entitlement being issued to a nearby landowner.

As described in Chapter 2, decisions on the allocation of new or traded licences in unregulated surface water systems are managed according to the state-wide sustainable diversion limits methodology, which was introduced as part of the *Our Water Our Future* reforms in 2004. The state-wide method was developed based on the advice of an expert scientific panel, and is a precautionary estimate that represents an upper limit on diversions beyond which there is an unacceptable risk that additional extractions may degrade the environment.

The state-wide sustainable diversion limits allows water corporations to make rapid assessments of new or traded licence applications, without undertaking site specific assessments. As the estimates of the state-wide sustainable diversion limits use a regionalised set of inputs they represent a precautionary limit which may be reviewed by Government based on more detailed local studies of the environmental winter flow requirements, rather than representing a fixed upper catchment limit.

The cost involved in undertaking a more detailed local study of the environmental winter flow requirements can be substantial, and in some cases will conclude that no further water may be allocated. In addition to the assessment of the environmental impacts local consumptive water users may also need to be consulted prior to issuing the licence as they may be impacted by the new entitlement. Although the process is costly, it is important adequate assessments of new or traded licence applications are undertaken, as issuing licences can result in detrimental impacts on the reliability of existing downstream consumptive water users, or on the environment. An important principle used in assessing new applications is that the applicant pays for the costs associated with the application, rather than the existing users, as it is the applicant that stands to benefit.

Connectivity between surface and groundwater licences

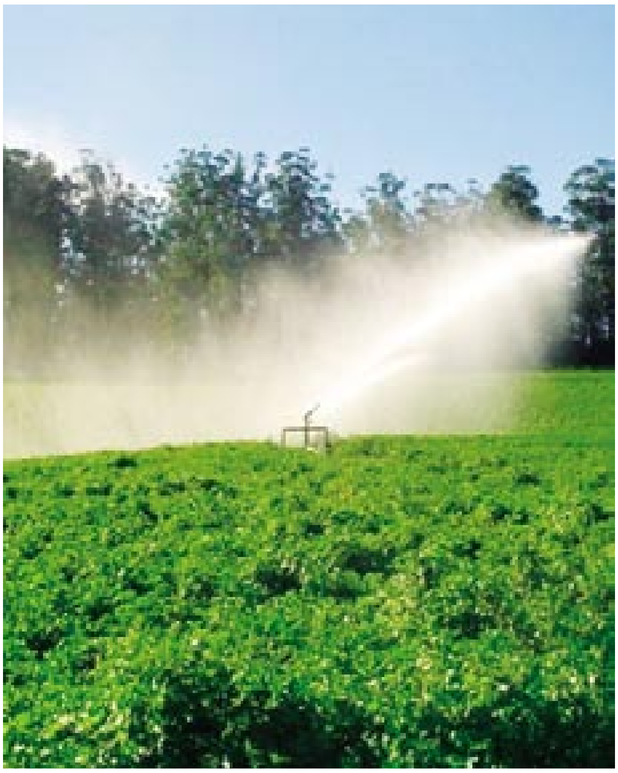
Separate licences are issued for taking surface water and groundwater, however in a few locations there is a relatively high level of connectivity between surface and groundwater systems which may benefit from a more integrated management approach.

Questions:

What opportunities are there to improve the decision making process for water entitlement applications in surface water catchments and groundwater systems?

How should water allocation and trading rules be adapted to respond to climate change?

Are there opportunities to better integrate the management of surface water and groundwater systems?



Watering crop (Photographer: VFF)

Groundwater opportunities

Groundwater availability and groundwater storage

There is significant potential to use groundwater to increase the security of water supply systems. Through the use of managed aquifer recharge (discussed in Chapter 3), water may be pumped into underground aquifers and stored until required, for example during times of drought. A range of issues need to be considered with the technique, however it is technically feasible and may offer considerable benefits across the State, including in the Gippsland Region. Furthermore, in the coming decades there may be other opportunities, such as using this new form of technology for carbon capture and storage.

In areas where groundwater entitlements are still below permissible consumptive volumes, there remain opportunities for additional groundwater extraction. Where entitlements are fully allocated, there are still opportunities for new users to extract groundwater if entitlements are purchased from existing users.

Question:

What opportunities are there to use managed aquifer recharge across the Gippsland Region?

Opportunities to adapt groundwater management

Along with existing demands on groundwater systems, there are a range of emerging industries that may soon be seeking to access aquifers, such as carbon capture and storage. As these new technologies emerge, appropriate regulation will be required to manage any potential impacts on the groundwater resource. The Strategy provides an opportunity to consider what types of management frameworks is needed.

Although further work is needed to improve our understanding of the relationship between offshore oil and gas production and rates of depletion and renewal in the aquifers underlying the Gippsland Region, it is clear that the water impacts of mining operations should be considered as part of the approval process for mining operations. As carbon capture and storage technologies develop, there may be opportunities to use this technology to reduce the impact of offshore oil and gas extraction on declining water levels in the aquifers underlying the Gippsland Region.

Question:

What opportunities are there to refine groundwater management in the Gippsland Region, and what are the risks?

Snowy Creek (Photographer: Alison Pouliot)

Balancing consumptive water use with the need to maintain a healthy environment

Adequate environmental flows are essential for maintaining a healthy environment that can support consumptive water, industry, tourism, recreation and other community and cultural values. It is important the right balance is struck between the volume of water we extract for consumptive uses, and the water we protect for in-stream environmental values. Opinions on what is the right balance vary, depending in part on the values of each individual.

As discussed in the previous chapters, some rivers in the Gippsland Region such as the Latrobe, Thomson and Macalister rivers are fully allocated and experience ecological stress under current flow conditions, while other rivers are not considered to be fully allocated.

Question:

Does the Gippsland Region have the right balance between water use by industry, urban and water protected for environmental, recreational and tourism purposes?

Adapting to change over the next 50 years

Opportunities to move water

Developing a robust water market

Trading water entitlements is a process that allows water to be reallocated between users, both in the short or long term, to respond to the changing needs of individual users. The water market allows for water to move from lower value to higher value uses, boosting the regional economic returns that can be made from the available water. Water trading also allows new developments to occur in systems where all available resources have been allocated, and helps individuals to manage their own risks of drought and reduced water availability.

The trading of water entitlements is sometimes limited by the ability to physically move water between users. A key reform to enable a more effective water market in the Gippsland Region would be the expansion of the existing water grid.

In addition to opportunities to improve the ability to trade surface water entitlements, there may be additional groundwater trading opportunities. Although the size and connectivity within groundwater aquifers imposes some physical limits to trade, groundwater trading occurs within groundwater systems across the Gippsland Region (as discussed in Chapter 2).

Questions:

What opportunities does water trading provide to urban water corporations, rural water users and the environment?

What limitations currently are there in moving water around the Gippsland Region?

Expanding connection opportunities

Interconnected systems provide greater security of supply for the region by allowing water to be moved around the region to where it is needed most, reducing the impact of localised droughts or water shortages resulting from climate change.

Interconnection can increase flexibility in balancing water supply and demand, and use of available capacity across the Gippsland Region. Interconnections can exist between towns within an urban water corporation's service area, or between separate water corporations. Although there are costs associated with the construction and operation of interconnections, they can provide a cost effective way of supplementing existing supplies in certain areas and lead to greater equity in security of supply between interconnected water corporations.

Although there are some large water distribution networks in Gippsland, many are not connected together.

Question:

Are there any opportunities to build upon existing connections? If so, who should bear the costs of any expansion?

Moving water between water users

The water market allows water to move between different water users, including urban water corporations. While Melbourne has not purchased water in northern Victoria, other urban water corporations such as Gippsland Water have purchased water from the water market to increase their water security.

During times of urban water restrictions, there may be opportunities for urban water corporations to manage supply risks through actively managing demands. For example, during times of restriction an industry reliant on the urban supply system may voluntarily restrict use in return for compensation from the urban water corporation. This may be a lower cost option for the urban water corporation (and their customer base) than securing new sources of water or increasing storage capacity, similar to the way in which load sharing is used in the power sector.

In the north of Victoria, Coliban Water, Lower Murray Water and North East Water have implemented arrangements whereby eligible urban users (generally limited to local businesses and community water users such as councils, sporting clubs and schools) purchase additional water on the temporary water market to ease the impacts of water restrictions on those facilities and businesses. These arrangements have allowed the continuity of community sport and helped secure employment in businesses affected by water restrictions.

Question:

During times of urban restrictions, what opportunities exist for urban water corporations to provide flexibility in levels of service across their customer base?

Avon River (Photographer: DSE)

Opportunities to improve and maintain environmental values

The challenge in a water scarce future is how to best manage the State's rivers, estuaries, wetlands and floodplains in the face of reduced water availability. It is likely this challenge will require water managers to become much more active and innovative.

To date, the Victorian Government and catchment management authorities have focused on:

- protecting priority areas of the highest community value from any decline in condition considering environmental, social and economic values
- maintaining the condition of ecologically healthy rivers.
- achieving an overall improvement in the condition of the remaining rivers
- preventing damage from future management activities.

This approach is based on management objectives identified with the community through regional river health strategies. The aim is to improve the resilience of river systems to survive through dry periods and enable recovery in normal to wet years. This includes integration with other river health works, such as fencing riparian zones to exclude stock access, removal of willow trees along riparian zones and replacement with native vegetation, and fish ladders to allow fish movement past weirs.

This approach may need to be improved to best manage the State's rivers, wetlands and floodplains in the face of reduced water availability. It will still be necessary to protect priority areas which are of the highest community value. However, in light of the expected increase in the frequency and duration of drought, key drought refuges will also need to become priorities – ensuring key assets survive dry years and have the capacity to recover in wet years.

In locations where increases in the volume of flow available for environmental values is required, Government's preferred approach to increase the environmental water reserve is to invest in water savings in the distribution system (such as the channel automation in the Macalister Irrigation District) as this enables the allocation of water to the environment with no impact on existing entitlement holders. The alternative option would be for the Government to consider buying back entitlements, as is currently being pursued by the Commonwealth Government in northern Victoria.

Approach to managing waterways and groundwater systems

Major projects looking to increase the volume of environmental water for rivers, aquifers, wetlands and estuaries experiencing ecological stress under the current flow conditions are:

- the recent provision of an environmental entitlement in the Macalister and Thomson rivers that is able to be actively managed for the best environmental benefit
- a project currently underway to understand the freshwater water requirements of the Gippsland Lakes
- ongoing investigations into the minimum environmental flows required to maintain and restore ecological objectives of rivers
- ongoing complementary works in rivers, such as streamside revegetation or the construction of fish ladders
- ongoing projects to better understand surface water and groundwater interactions
- the provision of a temporary 10 GL environmental entitlement from the Blue Rock Reservoir unallocated share.

State-wide management rules for managing water extraction in unregulated rivers and groundwater are being developed. When completed, they will provide a framework and a core set of standard conditions for irrigation and commercial use water licences.

Given the potentially significant impacts of reduced water availability from climate change to the existing flows in many rivers, estuaries, wetlands and floodplains across Gippsland, it must be acknowledged that we may not be able to maintain all of the current environmental values. For example, as sea levels rise the Gippsland Lakes are likely to become more saline which will alter the nature of this environmental system.

Question:

How should we adapt our management to best protect our environmental values from the threats posed by declined water availability?

Adapting to change over the next 50 years

State-wide opportunities

A number of issues considered in the Draft Northern Region Sustainable Water Strategy are relevant to water resource management across the entire State.
Two particular issues that warrant discussion are proposals relating to carryover and more intensive management of stock and domestic extractions. While the broad proposals for these issues continue to be developed, the Gippsland Region Sustainable Water Strategy will consider the implications of these proposals for the region.
In particular, whether there are any necessary adaptations or modifications to the proposals to accommodate the characteristics of the region.

Carryover

Carryover is a tool available to entitlement holders that enables them to manage their own water availability from year to year by carrying over unused water from one season to the next. Carryover enables individuals to make their own decisions on whether to use the water in the current year or save the water for the following year. This effectively allows them to manage their own reserves and their own risk. Entitlement holders have greater flexibility to use their water when it is of greatest value to them.

In 2007/08, the carryover arrangements for surface water introduced as a drought contingency measure during the 2006/07 season were made permanent. Victorian entitlement holders can carry over unused allocation in accordance with rules that were established. The rules limited the volumes that could be carried over and dealt with a range of other matters.

Carryover is effective in regulated systems, where there is a level of certainty of supply in the system. For systems with large storage capacity, such as the Latrobe and Thomson/Macalister, this tool is already employed by bulk entitlement holders such as Gippsland Water. While there may be less demand for carryover in the Gippsland Region than other areas in the State, it remains an important mechanism for entitlement holders and water managers.

While carryover for groundwater may not be appropriate for all aquifers, management areas which have moderate recharge rates and sufficient storage capacity would benefit from the introduction of carryover in the following ways:

- reliability of supply when groundwater (and surface water) allocations are low
- greater flexibility for licence-holders to manage their resources
- reduced reliance on finding someone to trade entitlements
- increased opportunities for transfer of groundwater
- investment opportunities where licence-holders might choose to carryover and transfer water in dry seasons.

Given the benefits of carryover, there may be merit in exploring the application of carryover to appropriate groundwater systems. Making carryover available would be subject to broad safeguards to ensure particular systems can sustain such practices and there are adequate monitoring and management frameworks in place.

Questions:

Should carryover be considered for groundwater systems in the Gippsland Region?

Would the region benefit from carryover in combination with managed aquifer recharge?

Management of domestic and stock use

Domestic and stock water use is the only significant water use that remains unregulated. Currently, a person has a statutory right to take and use water, free of charge, from a groundwater bore for domestic and stock use.
A person also has the right to take and use water flowing or occurring on their land if that water is not on a waterway. On a waterway, a person generally has the right to water for domestic and stock use, free of charge and without a licence if:

- the person has access to the waterway by a public road or reserve
- the waterway is on land the person occupies, or land immediately adjacent to the waterway
- the person has a farm dam on a waterway on their property that requires a works licence.

Historically the amount of water harvested for domestic and stock purposes from a groundwater bore, farm dam or waterway was relatively low compared with the total amount of water available. However, the demand for this water can be significant at a local level, placing stress on local water resources and reducing availability for other users and the environment. This cumulative impact is a result of increased demand for domestic and stock water by growing populations and lifestyle acreages, changing patterns of land use and the potential reduction in water availability as a result of climate change.

Farm dams for aesthetic or stock or domestic purposes are not subject to licensing requirements. As with all methods of extraction, an increase in the number of these unlicensed dams could have a considerable impact on water resources. The capacity of catchment farm dams in the Gippsland Region is equivalent to a major storage of just over half the capacity of Blue Rock Reservoir, or a capacity of about 129 GL. High concentrations of farm dams occur in the Strezelecki Ranges. Most of the dams do not have bypass facilities and only pass flow to downstream areas once they are full, and tend to capture the first run-off event after an extended dry period. The total surface area of small farm dams is greater for a given storage volume than larger storages, which means they exhibit greater evaporative losses.

Groundwater bores are used extensively throughout the Gippsland Region, particularly for stock and domestic use. Within groundwater management areas and water supply protection areas there are roughly 5,000 bores for stock and domestic use. The number of bores outside these areas is not readily available but would be expected to range from a few hundred to a few thousand based on similar ratios of other areas in the State.

While groundwater may be a more reliable water source than farm dams under climate change, like surface water it is also a limited resource. Increased extraction of groundwater for domestic and stock use has the potential to place aquifers and waterways at risk.

The need for more regulation of domestic and stock water use has been considered in the Draft Northern Region Sustainable Water Strategy and feedback and options are currently being considered.

Question:

Where should more intensive management be considered for stock and domestic water use in the Gippsland Region?

Land use change

As discussed in Chapter 3, land use change has the potential to significantly impact on water resources in the region. Changes in vegetation cover can occur in response to changing economic circumstances, the availability of resources including water, or changing demographics and societal needs. In the Gippsland Region, examples of land use changes impacting on water resources include the expansion of timber plantations, forestry, changes in agriculture, revegetation for biodiversity benefits or carbon capture, and emerging technologies using groundwater. In addition, vegetative cover has been changed by significant bushfire events such as those experienced during the summers of 2003, 2006/07 and 2009.

The Gippsland Region has been identified as one of the areas of Victoria most likely to experience plantation expansion into the future. The establishment of large-scale timber plantations may provide significant economic benefits to the region, however plantations also have the potential to significantly reduce surface water run-off and groundwater recharge.

Work is underway to consider the approach to the management of new plantation industries, to ensure the impact of new plantations on water resources is accounted for. This is consistent with commitments made in *Our Water Our Future* regarding addressing any significant water resource impacts from new plantations.

Question:

Given that changes in the plantation industry can reduce downstream water availability, should steps be taken to mange the impact on water resource availability?

Hardwood plantation (Photographer: DPI)

Having Your Say

This Discussion Paper aims to increase the understanding of water resources in the Gippsland Region and invites input into how water resources can be planned, managed and delivered in the future.

Submissions can be guided by, but not restricted to, the questions set out in Chapter 4. Some general questions which may also help to guide your submission include:

- Considering the information presented in this Discussion Paper, how would you like to see the Government plan for the future?
- Are there any additional options that the Gippsland Region should be looking at in order to deal with the challenges presented?
- What does a successful future look like in the Gippsland Region – what is the most important action we could all take to secure the region's future?

There is no set structure for submissions. They may range from a short letter outlining your views to a much more substantial document covering a range of issues. Submissions can be made in electronic or printed format. The electronic version should be a Microsoft Word document (.doc) or other text document (.txt, .rft).

All tracking changes, editing marks, hidden text and internal links should be removed from a submission before sending them to Department of Sustainability and Environment. Large logos, decorative graphics or photos should be removed or kept to a minimum in order to keep the file size as small as possible.

What you need to know:

- The information you provide in your submission, or any other response, will be used by the Department of Sustainability and Environment only in the development of this Sustainable Water Strategy. However, it may be disclosed to review panels and other relevant agencies as part of the overall consultation process.
- All submissions will be treated as public documents and will also be published on the internet for public access.
- All addresses, phone numbers and email details will be removed before submissions are published on the internet. Names will be retained on submissions. Formal requests for confidentiality will be honoured; however Freedom of Information access requirements will apply to submissions treated as confidential.
- If you wish to access information in your submission once it is lodged with the Department you may make a request by contacting the Administrative Support Officer of the Sustainable Water Strategies branch at the above address.

How to make a submission:

Please make your submission by 5pm on Friday 18 September 2009 by post or email to:

Department of Sustainability and Environment
Attention: Sustainable Water Strategies Branch
Office of Water
PO Box 500
East Melbourne VIC 3002

Email: gippsland.sws@dse.vic.gov.au
(If emailing please supply address details)

Next steps

After consideration of all submissions, the Government will develop a Draft Gippsland Region Sustainable Water Strategy, expected to be released in late 2009. There will be a further opportunity to comment on this Draft Strategy. The Final Gippsland Region Sustainable Water Strategy is expected to be released in the first half of 2010.

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Further Information

Further information about the Gippsland Region Sustainable Water Strategy is available from:

Department of Sustainability and Environment's customer service centre 136 186 or visit
www.ourwater.vic.gov.au/programs/sws/gippsland

Information regarding local water resource planning, including water supply demand strategies, is available directly from the water corporations:

East Gippsland Water
1300 720 700
www.egwater.vic.gov.au

Gippsland Water
1800 066 401
www.gippswater.com.au

South Gippsland Water
1300 851 636
www.sgwater.com.au

Southern Rural Water
(03) 5139 3100
www.srw.com.au

Information regarding regional river health strategies is available from the catchment management authorities:

East Gippsland Catchment Management Authority
(03) 5152 0600
www.egcma.com.au

West Gippsland Catchment Management Authority
1300 094 262
www.wgcma.vic.gov.au

Appendix 1 – water resource planning in Victoria

The following figure demonstrates the major water resource planning tools used in Victoria.

Water Resources	
Our Water Our Future & Next Stage of the Government's Water Plan 15 year resource assessments Sustainable water strategies Streamflow management plans Groundwater management plans	
Environment	**Consumptive**
Regional catchment strategies Regional river health strategies Regional management plans Drought response plans Environmental flow studies Annual watering plans	Water supply demand strategies Water plans Corporate plans Drought response plans Project business cases

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Glossary

Aquifer	A layer of underground sediments which holds water and allows water to flow through it.
Augmentation	Increase in size and/or number.
Baseflows	The component of streamflow supplied by groundwater discharge (or simulated from other environmental water).
Bulk Entitlement (BE)	The right to water held by water corporations and other authorities defined in the *Water Act 1989*. The BE defines the amount of water that an authority is entitled to from a river or storage, and may include the rate at which it may be taken and the reliability of the entitlement.
Cap	An upper limit for the diversion of water away from a waterway, catchment or basin.
Capacity share bulk entitlement	Provides the entitlement holder with a share of the storage capacity and inflows of water in the system. It also gives them the right to take water from specified points in the system.
Carryover	Allows entitlement-holders to retain ownership of unused water allocated or purchased from the current season into the following season (according to specified rules).
Catchment	An area of land where run-off from rainfall goes into one river system.
Catchment management authorities (CMAs)	Government authorities established to manage river health, regional and catchment planning, and waterway, floodplain, salinity and water quality management.
CSIRO	Commonwealth Scientific and Industrial Research Organisation.
Desalination	Removing salt from water sources – normally for drinking purposes.
Distribution losses	See system operating water.
Diversions	The removal of water from a waterway.
Drainage water	By-product of the distribution of irrigation water. Use is licensed.
Drought response plan	Used by urban water corporations to manage water shortages, including implementation of water restrictions.
Ecosystem	A dynamic complex of plant, animal, fungal and micro-organism communities and the associated non-living environment interacting as an ecological unit.
Effluent	Treated sewage that flows out of a sewage treatment plant.
Environmental flow regime	The timing, frequency, duration and magnitude of flows for the environment.
Environmental water reserve (EWR)	The share of water resources set aside to maintain the environmental values of a water system.
EPA Victoria	Environmental Protection Authority Victoria.
Estuaries	Zones where a river meets the sea, influenced by river flows and tides and characterised by a gradient from fresh to salt water.
Fit for purpose	Water which requires no further treatment for intended use.
Floodplain	Lands which are subject to overflow during floods. Often valuable for their ecological assets.
Gigalitre (GL)	One billion (1,000,000,000) litres.
Groundwater	All subsurface water, generally occupying the pores and crevices of rock and soil.
Groundwater management area (GMA)	A defined geographical area where groundwater has been intensively developed or has the potential to be developed. GMAs have boundaries defined for the purposes of ongoing management. Permissible consumptive volumes are set for all GMAs to prevent the resource being depleted or any adverse impacts occurring (see permissible consumptive volume).
Groundwater management plans	Created for water supply protection areas that have been or are proposed to be proclaimed under the *Water Act 1989* to ensure equitable and sustainable use of groundwater.
Groundwater management unit (GMU)	Either a groundwater management area (GMA) or water supply protection area (WSPA).
High-reliability water share	Legally recognised, secure entitlement to a defined share of water.
Inflows	Water flowing into a storage or a river.
Instream	The component of a river within the river channel, including pools, riffles, woody debris, the river bank and benches.
Low-reliability water share	Legally recognised, secure entitlement to a defined share of water. Available after there is enough water for high-reliability water share allocations and reserves. Previously known as sales water.
Megalitre (ML)	One million (1,000,000) litres.
National Water Initiative (NWI)	Agreed to and signed at the 2004 meeting of the Council of Australian Governments (COAG), with the agreed imperative of increasing the productivity and efficiency of water use and the health of river and groundwater systems in Australia.

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Non-residential	Water use in industry, commercial/institutional buildings, open spaces (parks and gardens) and the water distribution system.
Outfall	The site of discharge of a liquid from a pipe. Applied particularly to the point at which a sewer discharges to a treatment works or receiving water (such as river, creek or bay).
Passing flow	Flows that a water corporation must pass at its reservoirs before it can take any water for consumptive use.
Permissible consumptive volume (PCV)	Set by the Minister for Water and is the maximum volume of water that can be allocated from an area or water system. PCVs are imposed to prevent the resource being depleted or adverse impacts, such as declining groundwater levels, reduced base flows in rivers and streams and changes to water quality.
Potable	Suitable for drinking.
Ramsar	Internationally recognised wetlands (based on the Convention on Wetlands, signed in Ramsar, Iran, in 1971).
Recharge (to groundwater)	The process where water moves downward from surface water to groundwater due to rainfall infiltration or seepage/leakage.
Recycled water	Water derived from sewerage systems or industry processes that is treated to a standard appropriate for its intended use.
Regional River Health Strategy	The key strategy for the protection of river values in each catchment management region in Victoria.
Regulated systems	Systems where the flow of the river is regulated through the operation of large dams or weirs.
Reliability of supply	Represents the frequency with which water that has been allocated under a water entitlement is expected to be able to be supplied in full.
Reservoir	Natural or artificial dam or lake used for the storage and regulation of water.
Residential use	Water use in private housing.
River basin	The land into which a river and its tributaries drain.
Run-off	Precipitation or rainfall which flows from a catchment into streams, lakes, rivers or reservoirs.
Salinity	The total amount of water-soluble salts present in the soil or in a stream.
Seasonal allocation	The specific volume of water allocated to a water share in a given season, defined according to rules established in the relevant water plan.
Sewerage	The pipes and plant that collect, remove, treat and dispose of liquid urban waste.
Share of delivery capacity	An entitlement to have water delivered to a property.
Stormwater	Run-off from urban areas. The net increase in run–off and decrease in groundwater recharge resulting from the introduction of impervious surfaces such as roofs and roads within urban development.
Streamflow management plan	Prepared for a water supply protection area to manage the surface water resources of the area.
System operating water	Water released out of storages to operate river and distribution systems (to deliver water to end users), provide for riparian rights and maintain environmental values and other community benefits.
Unbundling	Separation of traditional entitlements into a water share, delivery share and a water-use licence.
Unregulated systems	River systems with no large dams or weirs to regulate flow and all groundwater sources
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. Formerly known as water authorities.
Water market	Market in which the trade of permanent and temporary water is allowed under certain conditions.
Water plans	Outline the services water corporations will deliver over a three year regulatory period and the prices that they will charge.
Water right	Previously rights to water held by irrigators. As a result of 'unbundling', these have now been separated into a water share, delivery share and water use licence.
Water share	A water share is a legally recognised, secure share of the water available to be taken from a water system. It can be traded permanently or leased.
Water supply protection area (WSPA)	An area declared under the *Water Act 1989* to protect the groundwater or surface water resources in the area, through the development of a management plan. Permissible consumptive volumes are set for all WSPAs to prevent the resource being depleted or any adverse impacts occurring (see permissible consumptive volume).
Water-use licence	Authorises the use of water on land for irrigation.
Wetlands	Inland, standing, shallow bodies of water, which may be permanent or temporary, fresh or saline.
Yield	The quantity of water that a storage or aquifer produces.

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