The Gellibrand River: balancing environmental and urban water demand in a climate of change

Greg Williams
Environmental Water Reserve Officer
Corangamite Catchment Management Authority
Colac, Victoria
Australia

Abstract

Unlike the national average, 70 per cent of extracted water in the Corangamite region goes to urban rather than agricultural use. This presents considerable challenges to water managers to simultaneously maintain river health and deliver high security urban water with the prospect of reduced flows through climate-change.

The Gellibrand River in south-west Victoria is one of the few significant rivers remaining in the state widely regarded as ecologically healthy despite significant extractions for urban and rural use. It has long been earmarked for even greater extraction. The Victorian Government therefore has declared the Gellibrand River catchment to be one of twenty-one priority unregulated rivers in Victoria.

The Corangamite Catchment Management Authority (CCMA) recently completed a flow study of the Gellibrand River system using the FLOWs methodology and a daily-step REALM model. The study confirmed what was already suspected – that the flow regime (the primary driver of river health) is largely intact. It is for this reason that the river has been able to sustain its assemblage of 12 native fish freshwater species (six of which considered rare or threatened in Victoria). The river supports Victoria's premier population of River Blackfish, both in size (up to 1 kg) and number, and has only one introduced species, the Brown Trout.

The Central Region Sustainable Water Strategy (Central SWS) was undertaken to plan for the next 50 years to ensure safe, reliable water supplies in the Central Region, which includes Geelong. One of the options identified in the Central SWS Discussion Paper was to connect the West Gellibrand Reservoir to the Geelong water supply and extract up to an additional six gigalitres from the upper Gellibrand. In addition the Gellibrand River is the key water source for the south western coastal city of Warrnambool and further extraction in the upper reaches may impact on security of supply for Warrnambool.

In addition to the increased urban and peri-urban demand is the spectre of the climate change scenarios. The REALM model developed for the Gellibrand covers the period 1970 to 2004. Whilst this time period is too short to come to any long-term conclusions, the trend is unmistakeable. CSIRO climate modelling for the Otway Ranges river basin predict a loss in run-off of between –10% and –30% by 2050, and –10% and –50% by 2070.

These challenges are further compounded by the dislocation of urban populations from their water supply catchments and their understanding of impacts of extraction to these catchments.

Introduction

The greatest challenge facing the Corangamite CMA with respect to the Gellibrand River is maintaining an ecologically healthy river in the face of growing pressure to extract water for urban use, compounded by decreasing flows as a result of expected climate change.

The Gellibrand River is situated in south-west Victoria midway between Geelong and Warrnambool (Figures 1 and 2). It is the largest stream in the Western portion of the Otway Ranges having a median flow of 284,366 ML (Figure 3). The catchment has an area of approximately 1200 km^2 and consists of eucalyptus forests and cleared agricultural land. It boasts the highest rainfall in the state, ranging from 800 mm to 1800 mm annually. The majority of its tributaries rise to the south where the highest rainfall is recorded. Its uppermost tributaries rise on the northern slopes of the Otway Ranges, south of the township of Gellibrand. From here it flows approximately south-west until it forms an estuary near the township of Princetown where it enters Bass Strait.

Figure 1: The Gellibrand catchment in the context of Victoria and the Corangamite region

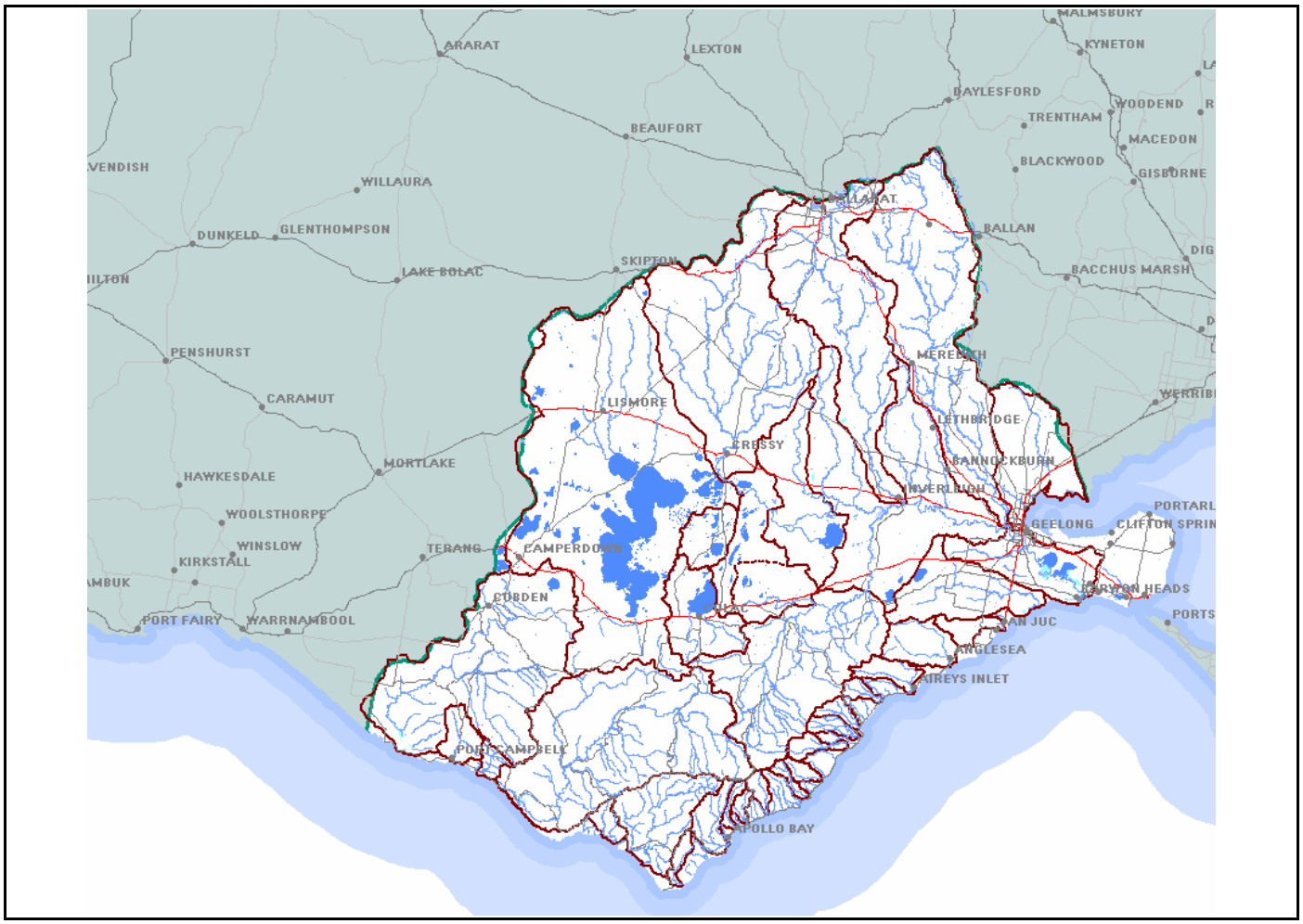


Figure 2: The Gellibrand River and its tributaries

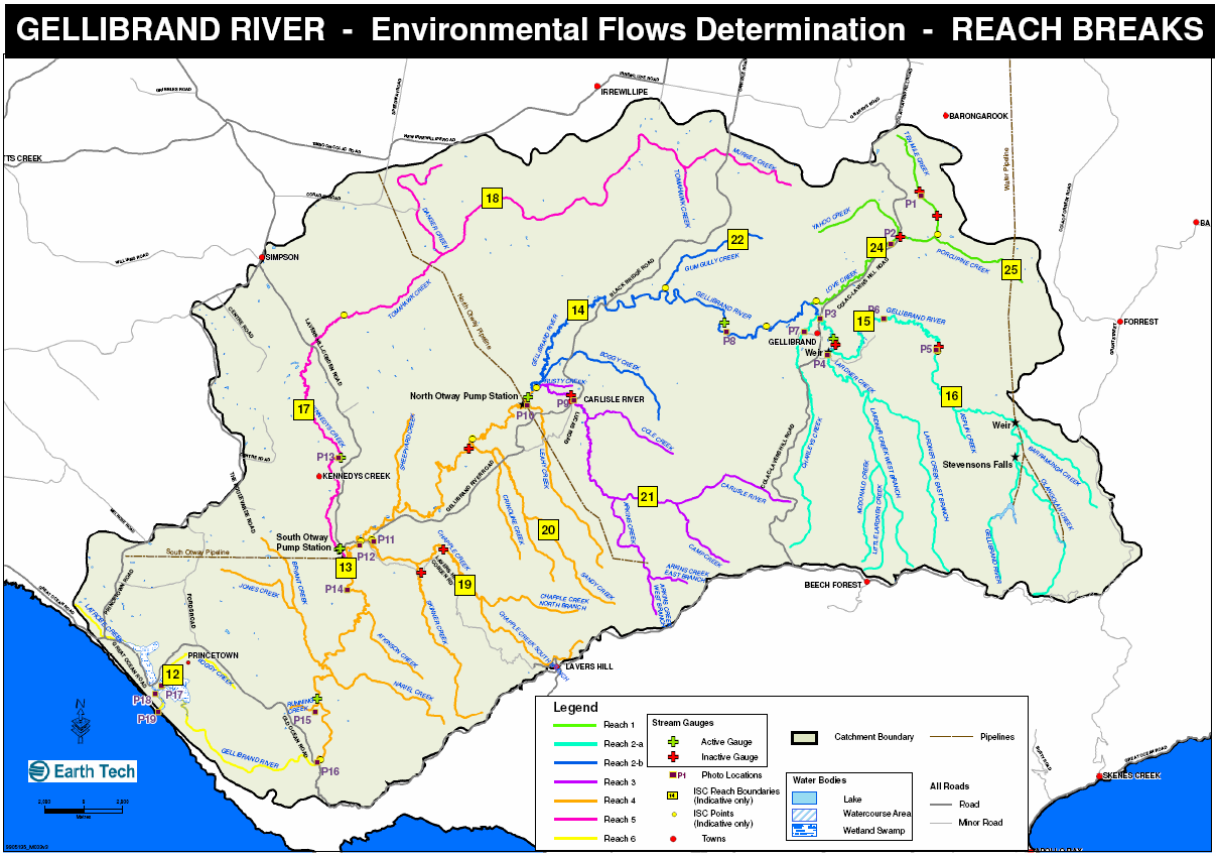
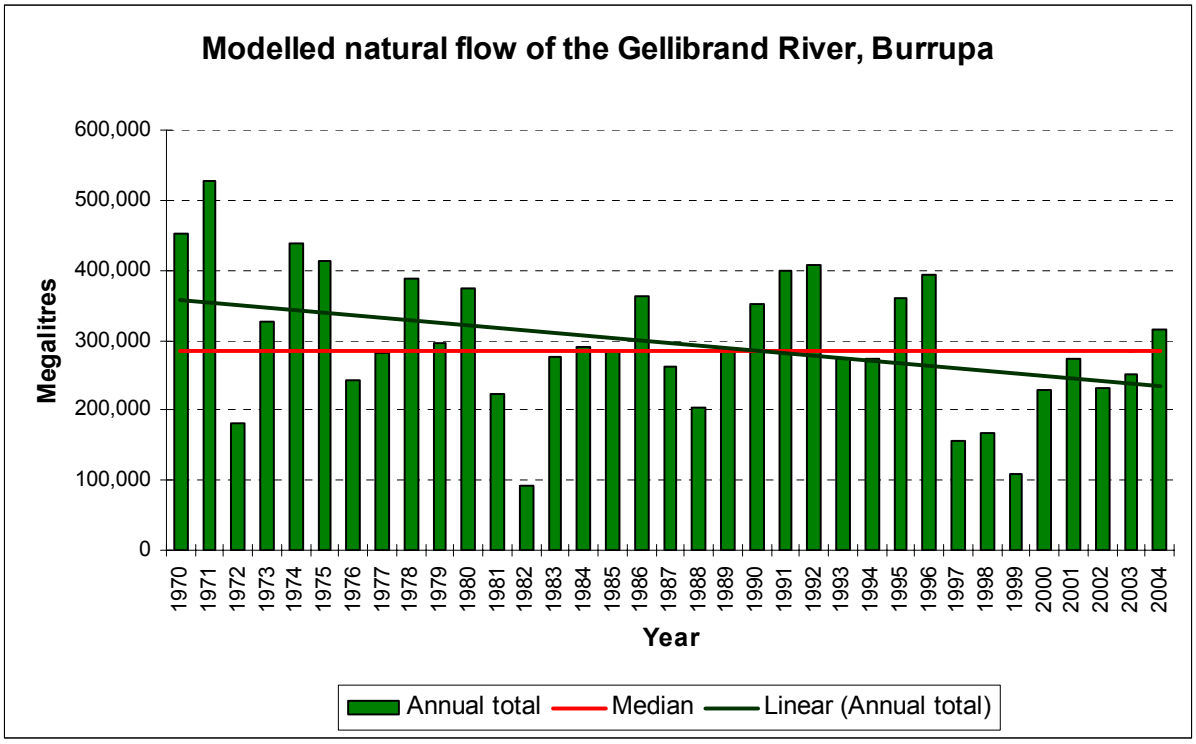


Figure 3: Modelled annual natural flow of the Gellibrand River at Burrupa (1985 is the median year).



The Gellibrand River still flows through significant areas of intact native vegetation which provide a degree of naturalness. These areas provide examples of remnant habitat and are of importance to both aquatic and terrestrial fauna. However there are ongoing threats to the river in the mid to lower sections through loss of riparian vegetation, invasion by willows and loss of stream structure caused through sedimentation. The river is a major source of urban supply for Warrnambool, Colac and many Western District townships. It also provides water resources for valuable agricultural uses, comprising, dairy, stock and domestic requirements.

The potential loss of further habitat, coupled with competing demands on water resources for urban and agricultural use and a need to protect environmental values, particularly in periods of low flow, highlight the importance of determining flow share arrangements. The Victorian Government's method of closely managing an unregulated catchment is through a Stream Flow Management Plan.

The Victorian Government, through the implementation of the *Our Water Our Future Action Plan*, has declared the Gellibrand River to be one of twenty-one priority unregulated rivers because of its diverse range of uses and important environmental qualities. These rivers will each have a Stream Flow Management Plan developed to maintain or enhance their environmental flows to retain and where possible, enhance fish and other aquatic biota within the river

The process of developing an Stream Flow Management Plan involves establishing the environmental, urban and rural demand prior to negotiating flow sharing arrangements through stakeholder and community consultation.

Environmental values

The river provides important habitat for aquatic species and creates an important biological corridor for wildlife. The river and its tributaries are significant because of the assemblage of 13 species of native freshwater fish, of which 6 species are considered rare or threatened in Victoria (Table 1). Unlike many other streams, which have a high proportion of introduced species, the Gellibrand has only one, the Brown Trout. In particular, the river supports Victoria's best population of Blackfish both in size (up to 1 kg) and number. As such the Gellibrand is considered to be an important recreational angling water, focused mainly on River Blackfish, but it is also one of the primary Brown Trout waters in the Otway Ranges.

The Gellibrand estuary contains 19 species of fish and provides important habitat necessary for the completion of the life cycle of several fish species. Tupong and Common Galaxias migrate from the fresh water to spawn in the estuary, whilst eels and lampreys pass to and from the estuary as part of their life cycle. Flushing flows are an essential part of maintaining suitable habitat in the estuary.

Table 1: Freshwater fish of the Gellibrand River catchment

Common Name	Scientific name	Conservation status
Native		
Short-finned Eel	*Anguilla australis*	Common
River Blackfish	*Gadopsis marmoratus*	Insufficiently known
Broad-finned (Climbing) Galaxias	*Galaxias brevipinnis*	Rare
Common Galaxias	*Galaxias maculatus*	Common
Mountain Galaxias	*Galaxias olidus*	Insufficiently known (FFG listed)
Spotted Galaxias	*Galaxias truttaceus*	Rare
Pouched Lamprey	*Geotria australis*	Rare
Short-headed Lamprey	*Mordacia mordax*	Common
Southern Pigmy Perch	*Nannoperca australis*	Common
Flat-headed Gudgeon	*Philypnodon grandiceps*	Common
Australian Grayling	*Prototroctes maraena*	Listed as vulnerable (EPBC & FFG)
Tupong	*Pseudaphritis urvilli*	Common
Australian Smelt	*Retropinna semoni*	Common
Introduced		
Brown Trout	*Salmo trutta*	Common

Rural water

Grazing of dairy and beef cattle is the dominant form of land use in the catchment consisting of 298 km^2 of grazing land, with the remainder being eucalypt forest. Whilst dairying is the most common enterprise on the river flats where irrigation licences are held, more recently there has been a rapid increase in Blue Gum plantations, in addition to the expansive area of established pine plantations.

Southern Rural Water is the delegated authority for the issue of licences and the control of water taken from the Gellibrand River in accordance with the *Water Act 1989*. The rural water commitments in the Gellibrand River catchment are summarised below in Table 2.

Table 2: Rural water commitments in the Gellibrand catchment.

Licence category	Number of licences	Volume (ML)
Direct pumping (or Annual Diversion) licences	***59***	***1627.1***
- Commercial	2	5.7
- Dairy	31	92.4
- Industrial	1	9.0
- Irrigation	25	1520.0
Domestic and stock	***37***	***81.4***
Winter-fill	***5***	***335.0***
Sporadic conversion	***7***	***83.0***
Private rights to water	***Unknown***	***Unknown***
Farm dams (SDL estimate)		***3,994.0***
TOTAL	***108***	**2126.5**

Urban water

The Gellibrand catchment has large urban water commitments with two urban water authorities taking a total of close to 15,500 ML per annum, supplying many Western District townships from Colac to Warrnambool. The urban water commitments from the Gellibrand catchment are summarised below (Tables 3 and 4)

Table 3: Barwon Water's Gellibrand water commitments

Barwon Water's Gellibrand water commitments	Approx. number of customers	Approx. volume (ML)
Colac, Irrewarra, Barpinda, Cressy, Coragulac, Cororooke, Warrion, Ondit - West Gellibrand Reservoir (2,000 ML) - Olangolah Reservoir (136 ML)	15,000	3,400
Gellibrand village - Lardners Creek (direct pumping)	500	20
TOTAL	**15,500**	**3,420**

Table 4: Wannon Water's Gellibrand water commitments

Wannon Water's Gellibrand water commitments	**Approx. number of customers**	**Approx. volume (ML)**
Warrnambool via Carlisle River, Simpson, Cobden, Camperdown, Lismore, Derrinallum, Terang, Noorat, Glenormiston, Allansford, plus a number of small settlements and approximately 1000 rural properties - Arkins Creek (three gravity fed weirs) - North Otway Pipe Line (NOPL) - Gellibrand River downstream of the Carlisle River confluence (22.5 ML/day) Warrnambool (direct) - South Otway Pipe Line (SOPL) - Gellibrand River upstream of the Kennedy's Creek confluence (22 ML/day)	50,000	**10,000**
TOTAL	**50,000**	**10,000**

Environmental flows

In preparation for the commencement of the Stream Flow Management Plan process, the Corangamite CMA recently completed an environmental flow study of the Gellibrand River system using the FLOWs methodology. The aim of the investigation was to establish the 'ideal' minimum flow requirements under modelled natural conditions for the flow-dependent ecological assets.

Prior to the commencement of the actual flows study, a daily-step REALM model was developed, giving daily flow datasets for natural, current and full flow development scenarios (Table 5) at nine points across the catchment. This allowed the flow study to develop flow recommendations under modelled natural conditions, and examine the impact of the current and full Bulk Entitlement (BE) uptake.

Table 5: Description of the REALM model flow scenarios

Flow scenario	Description
Natural	Model set up to approximate natural conditions with the following removed from the system: urban demands, rural demands, farm dams, system storages
Current	Model set up to approximate current system configuration and operation including urban demand, farm dams, rural demands, and storages
Full	Model set up to approximate current system configuration and operation but has been run with Full Bulk Entitlement Level of Development Demands

The catchment was divided into six reaches (Figure 2), and for each reach the following process followed:

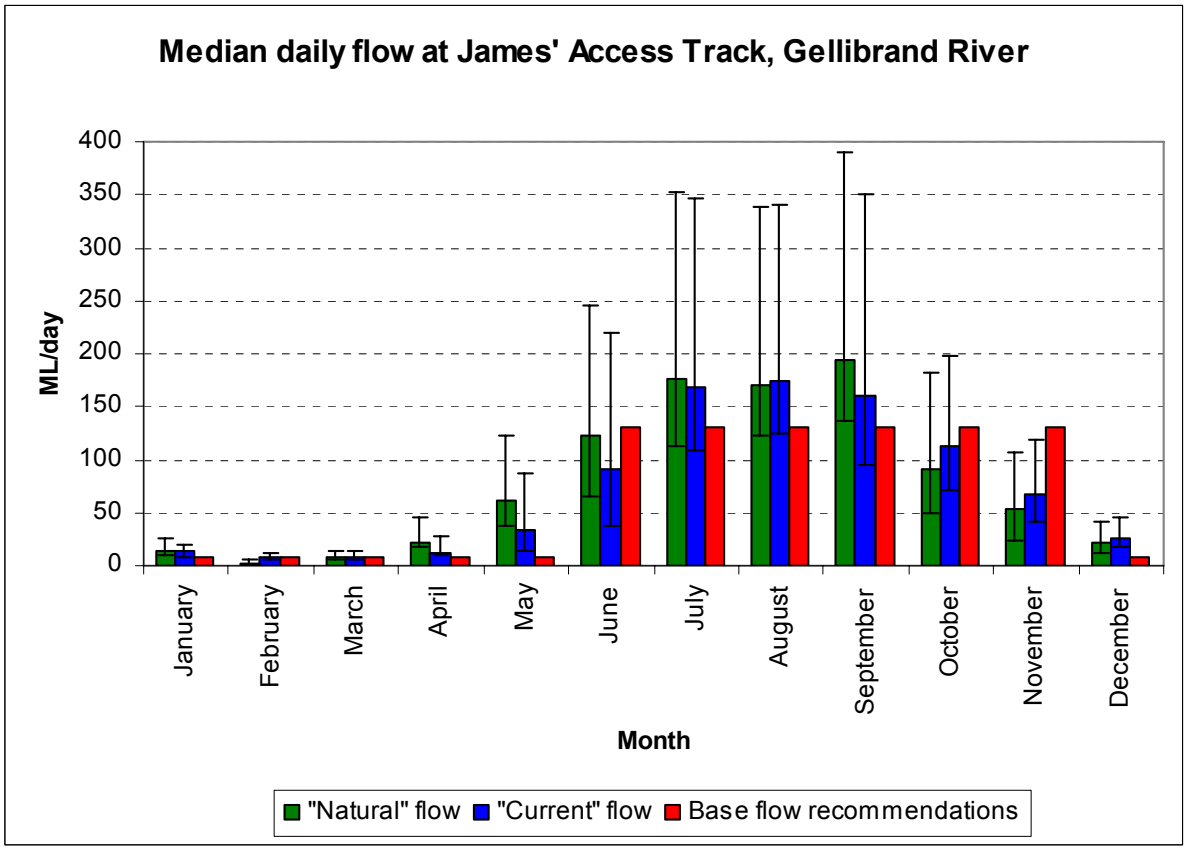
- Current environmental assets identified
- Flow-dependent assets expected to be associated with an ecologically healthy waterway identified
- Representative site selected and a number of cross-sectional surveys drawn
- Cross-sectional data combined with daily flow data
- Environmental objectives developed
- Key flow related events and flow components to meet each environmental objective identified
- Flow objectives developed
- Recommendations to meet each flow objective developed

The study confirmed two things that were already suspected: firstly that the flow regime is largely intact; but secondly that urban and rural extractions cause stress during summer. However the most significant aspect of the study was that for the first time the investigation was able to quantify this stress, putting the environment on an equal footing with rural and urban sector for the upcoming Stream Flow Management Plan process.

Given the relative volumes of rural versus urban extractions, the majority of the impact is generated by the urban sector. As a result, the impact of urban extractions is concentrated on the two study reaches where these extractions occur, and the estuary downstream.

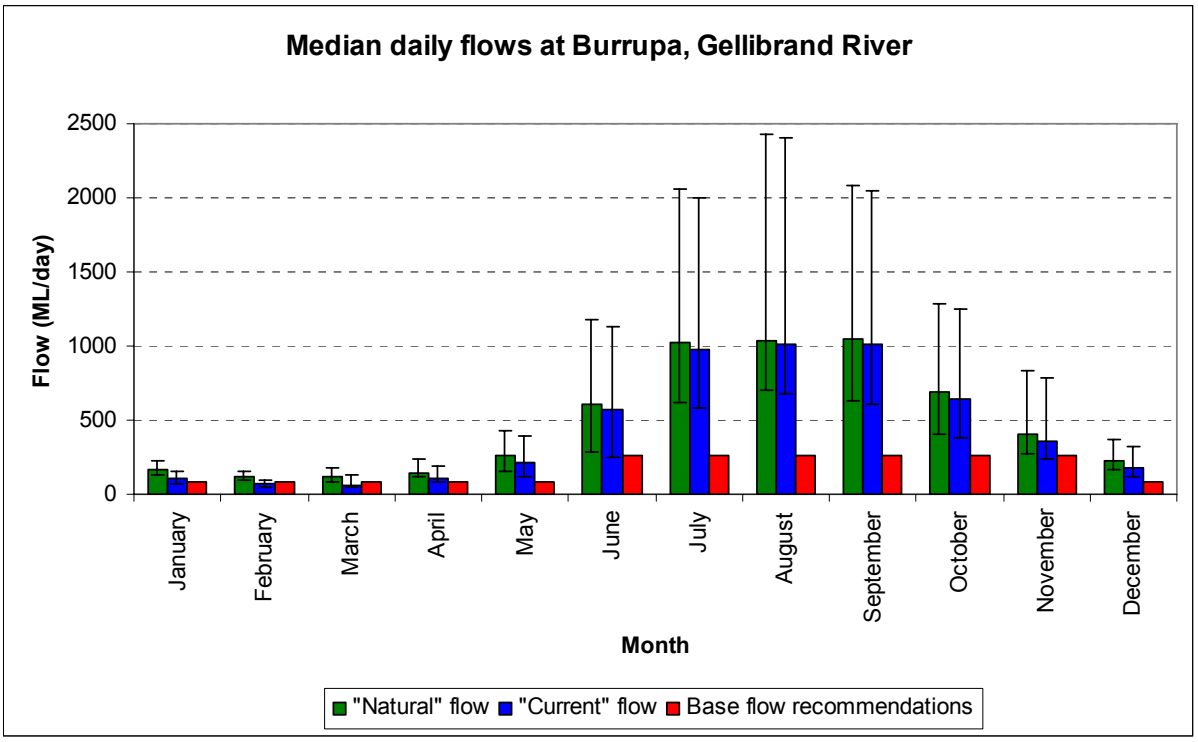
A comparison of the environmental flow recommendations to the natural and current flow in the reach immediately below the West Gellibrand Reservoir shows that, assuming full implementation of the environmental flow recommendations that water could only be stored in the reservoir for 7 months of the year (Figure 4).

Figure 4: Median daily flows compared to the base environmental flow recommendations below the West Gellibrand Reservoir



A similar comparison in the reach where Wannon Water extracts its water shows that natural flow exceeds the environmental base flow recommendations in all 12 months (albeit marginally in some months) (Figure 5). Whilst this might suggest that their position is not as critical as that of Barwon Water's, the absence of a large off-stream reservoir makes them particularly vulnerable.

Figure 5: Median daily flows compared to the base environmental flow recommendations in the lower Gellibrand River at Wannon Water's off-takes

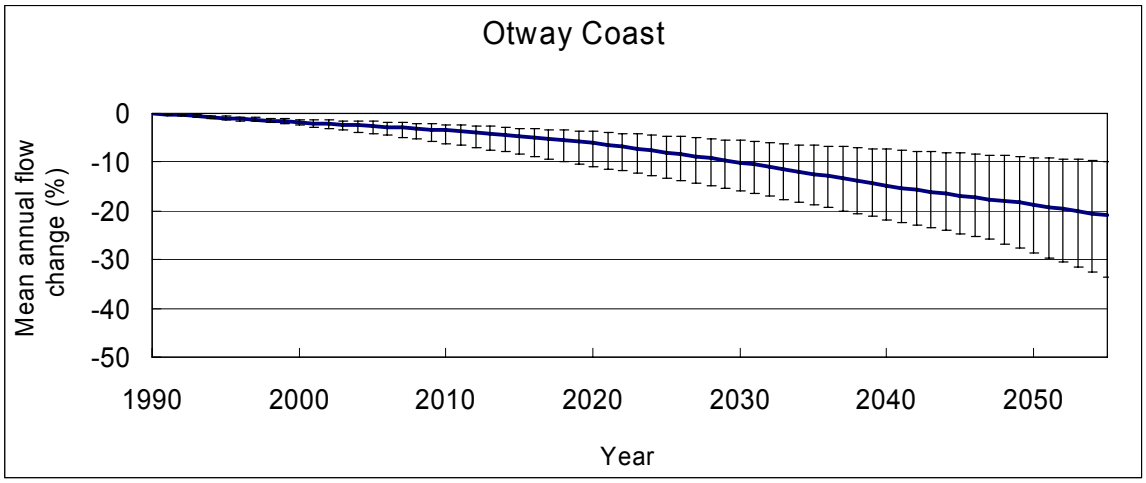


Compounding Wannon Water's demand squeeze is an option presented in the *Discussion Paper to the Sustainable Water Strategy for the Central Region* to connect the West Gellibrand Reservoir to the West Barwon Reservoir. This would increase supplies to the Greater Geelong region by up to 6,000 megalitres (6 gigalitres) which are currently under pressure due to population increases and below average rainfall for the past ten years. One of the guiding principles underpinning the Strategy is to "protect and where possible improve the health of rivers and aquifers". This means that additional harvesting from the upper Gellibrand would have to occur once environmental flow recommendations were met. Given this proviso, the yield and viability of constructing a pipeline between the two reservoirs, along with the impact on Wannon Water's current and future extraction regime would have to be assessed. Whilst this option is not currently being pursued by the Victorian Government, it remains a possibility.

Climate change

The spectre of climate change looms large over the Gellibrand River and the Otway Coast basin. The REALM model developed for the Gellibrand covers the period 1970 to 2004. Whilst this time period is too short to come to any long-term conclusions, the trend is unmistakeable (Figure 3). CSIRO climate modelling for the Otway Ranges river basin predict a loss in run-off of between –10% and –30% by 2050 (Figure 6), and –10% and –50% by 2070.

Figure 6: Predicted impact of climate change on run-off for the Otway Coast (Source: Jones, 2005)



Growth in water demand

Both Barwon Water and Wannon Water have conducted preliminary demand forecast planning. To date this modelling has been based on the expected population growth and assumed that the yield from their systems remains constant (Figures 7 and 8). Barwon Water is not expecting demand to outstrip supply until 2030 whilst Wannon Water's projection is significantly sooner at around 2020. No doubt as the modelling becomes more sophisticated and incorporates various demand management strategies combined with climate change scenarios, these intersection points will change. Whilst the Gellibrand system probably has enough capacity to soak up this additional demand, combined with the expected deficit created by climate change, the environment could once again bear the brunt.

Figure 7: Barwon Water's demand forecast for the Colac region (Source: Barwon Water, 2003, p. 15)

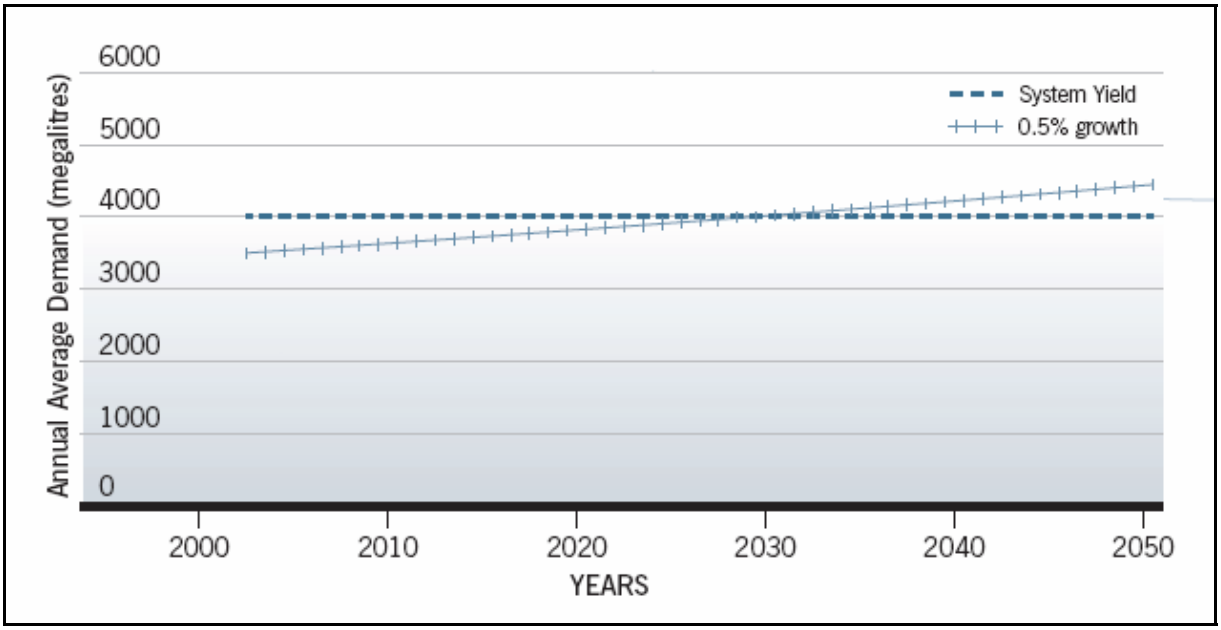
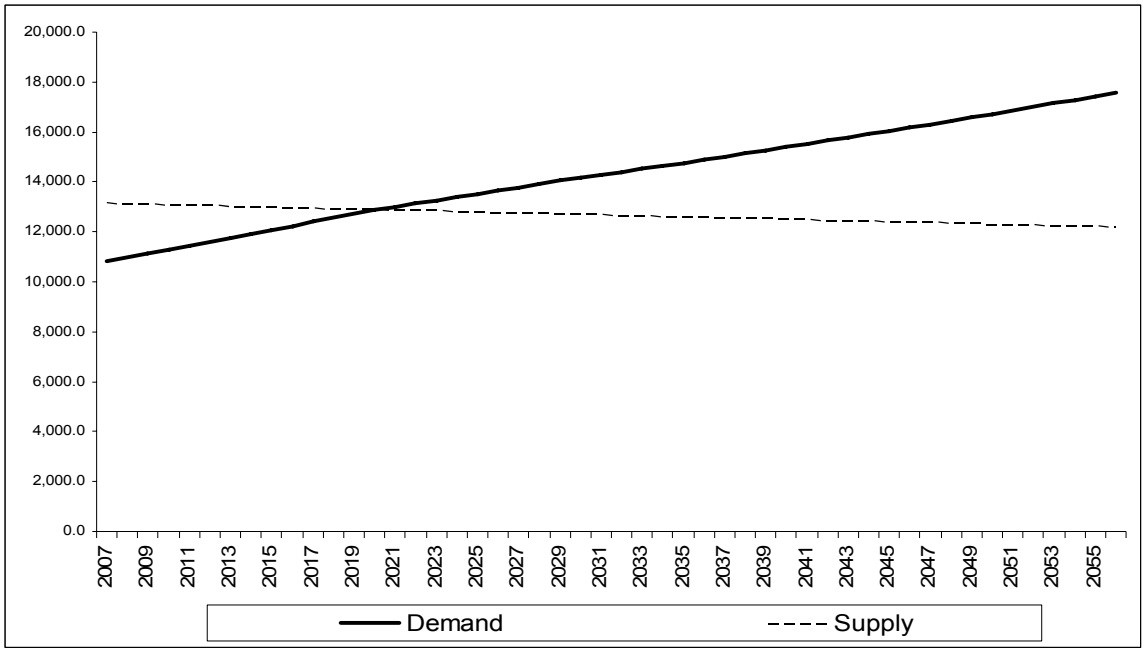


Figure 8: Wannon Water's demand forecast from their Otway system



Complimentary CMA activities

With water pricing being regulated and fixed by the Essential Services Commission, Adam Smith's 'invisible hand of supply and demand' simply doesn't apply. As such, economic rationalism and the free-market economy have largely bypassed water allocation. In the absence of pricing or other mechanisms to signal the volume of water available in the catchment for consumers, the Corangamite CMA has to look for alternative and innovative ways of linking urban populations to their catchments.

To this end, Corangamite CMA conducts a community education program that includes the following elements:

- School program support i.e. funding opportunities, school visits and teacher support materials.
- Free public events including National Water Week activities.
- Special programs such as getting up close and personal with a platypus and freshwater circus events.
- Contact point for Natural Resource management organisations and information about these organisations and their programs within the Corangamite region (webpage coming soon).
- Additional services such as teacher training and curriculum consultation.

In future this may also involve participation in dialogue on 'fit-for-purpose' water use policy and coming to grips with the 'yuk' factor of potable recycled water.

Despite flow regime being the primary driver of river health, it is not the only measure being pursued to maintain the health of the Gellibrand River. Over the past five years, the Corangamite CMA has invested approximately $1.1 million managing the Gellibrand River Restoration Project, aligned with priorities in its Regional River Health Strategy. With its focus on improving water quality within the Special Water Supply Catchments of the Gellibrand and Carlisle Rivers the following works and activities have been completed:

- 60 km of riparian willows either removed or poisoned;
- 55km of protective fencing installed by landholders to restrict direct stock access to waterways;
- 150,000 indigenous seedlings planted by landholders and the CMA to improve water quality and biodiversity;
- 25 off stream watering points installed by landholders;
- 40 voluntary conservation agreements have been signed by landholders; and
- 2 fishways installed and erosion control works undertaken;

The project, in its current form will be wound up at the end of June 2008, by which time a further:

- 9km of willows will have been removed protecting and linking previous works;
- 50,000 native seedlings planted; and
- 17km of fencing erected.

The effectiveness of all works will then be monitored.

The challenges

Water comes out of taps, not catchments. Or at least that is the level of understanding the majority of urban consumers had up until the last ten years of below average rainfall. Therefore the challenge to maintain the Gellibrand River as an ecologically healthy river in the face of urban pressure and climate change is compounded by the dislocation of urban populations from their water supply catchments and their understanding of impacts of extraction to these catchments.

Without a doubt the *Our Water Our Future Action Plan* has changed the landscape of water management in Victoria. For the first time in the history of water management in Victoria, the environment has been recognised as a legitimate user with its own allocation in rivers and

aquifers – the Environmental Water Reserve (EWR). The significance of this step is that Catchment Management Authority's, as the designated managers of the EWR are now in the position of negotiating with urban and rural water authorities on a more or less equal footing. No longer can consumers expect to automatically increase their allocations without paying due regard to the environment.

With the exception of the small number of people that reside in the village of Gellibrand, the urban populations that rely on the Gellibrand catchment, like the majority of Australia, are somewhat dislocated from their water supply. At the simplest of levels, customers receive a water bill from their water authority with nothing to suggest where their water is sourced from, the catchment condition or the volume in storage. Urban customers have also come to expect an endless supply from the tap with water restrictions. Given that below average rainfall and drought are well-known characteristics of the Australian climate, perhaps urban water management should more accurately reflect the long-term average.

Furthermore, communities and stakeholders are just starting to come to grips with the chance that the below average rainfall Victoria has experienced for the past 10 years may become the norm for the foreseeable long-term. In this context, the pre-1996 average may yet represent a 'wet' period of 40 – 50 years in duration. The 'drought-breaking' rains consisting of successive years of median or better rainfall (e.g. 1982/83 Figure 3) that sit within the collective Australian consciousness may be a thing of the past. This being a distinct possibility, a paradigm shift is required in our approach to water management. To minimise climate change impacts Corangamite CMA will continue its habitat protection and river restoration program to ensure that the health and resilience of ecosystems are maintained and improved over time.

The major challenge and a greater shift in focus will be the need for Corangamite CMA in stakeholders to increase the capacity and capability of urban and rural populations to understand the importance and essential service provide by the Environmental Water Reserve in supporting our economic and social well being.

References

Barwon Water 2003 *Water Resources Development Plan: water for tomorrow*. Barwon Water, Geelong.

Earth Tech 2005 *Environmental Flow determination for the Gellibrand River: Site Paper*. Corangamite Catchment Management Authority, Colac.

Earth Tech 2006 *Environmental Flow determination for the Gellibrand River: Issues Paper*. Corangamite Catchment Management Authority, Colac.

Earth Tech 2006 *Environmental Flow determination for the Gellibrand River: Final Recommendations*. Corangamite Catchment Management Authority, Colac.

Jones, R.N. 2005 *Guidance for the use of scenarios of runoff change for Victorian catchments* (report and MS Excel program SWMA Flow-P-Ep Scenarios.xls). CSIRO Atmospheric Research, Melbourne.

Jones, R. N. and Durack, D. J. 2005 *Estimating the Impacts of Climate Change on Victoria's Runoff using a Hydrological Sensitivity Model.* CSIRO Atmospheric Research, Melbourne.

Sinclair Knight Merz, Cooperative Research Centre for Freshwater Ecology, Freshwater Ecology (NRE) and Lloyd Environmental Consultants. 2002 *The FLOWS Method: a method for determining environmental water requirements in Victoria.* The State of Victoria, Department of Natural Resources and Environment, East Melbourne.

Victorian Government 2004 *Our Water Our Future: Securing our water future together*. State of Victoria, Department of Sustainability and Environment, Melbourne.