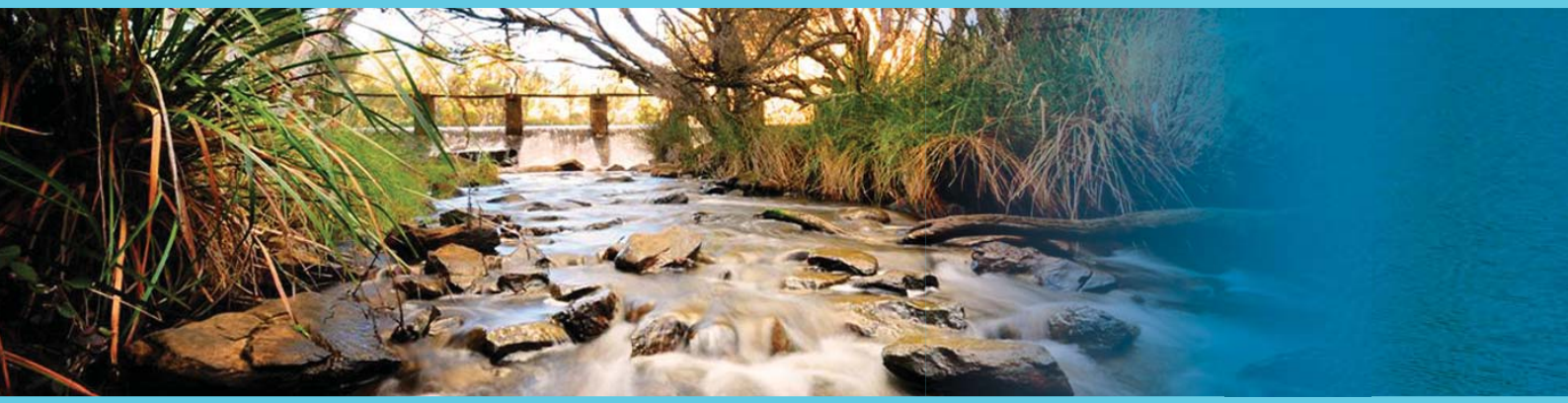
Water Forever: South West

Final Report

WATER CORPORATION



"This report has been developed with considerable input from communities and stakeholders throughout the region over an 18 month period"

Minister's Foreword

Long-term planning to secure drinking water supplies in the South West region of Western Australia is essential to support the growth of towns and to combat effects of a persistent drying climate.

The South West has experienced a decline in rainfall, including two of the driest winters on record in 2010 and 2012, and at the same time has experienced continued population growth in many towns.

The State Government, through the Water Corporation, has invested over $290 million in the last five years to secure water supply schemes in the South West. This includes water efficiency initiatives in local towns, along with investment in:

- A new groundwater bore and treatment plant for the Margaret River–Cowaramup–Prevelley water supply scheme.
- A new water treatment plant in Picton to support the rapidly growing suburbs north of Bunbury.
- Connecting Manjimup to the Warren-Blackwood Regional Water Supply Scheme to improve water security in dry years.
- Doubling the capacity of the Millstream Dam near Bridgetown as the central water source for the Warren-Blackwood Regional Water Supply Scheme.

These upgrades, and the fantastic work the community has done to reduce water use, have helped secure water supplies in the short to medium-term.

The State Government recognises the need to continue long-term water planning to secure water supplies for the region for all water users and for the environment.

The Department of Water regulates water use, conducts scientific assessments, identifies future water demand for all sectors across the State and provides advice to Government on water services.

The department has partnered with the three South West water service providers (the Water Corporation, Aqwest and Busselton Water) to plan for the scheme water needs of their customers that align with the State's growth projections and efficiency targets.

I am pleased to present the Water Corporation's *Water Forever: South West* report, which focuses on meeting the water supply challenges faced by the Corporation, and its customers, over the next 50 years.

The report provides a strategic framework for the future - with options that cover water efficiency, water recycling and the development of new water sources.

Importantly, this report has been developed with considerable input from communities and stakeholders throughout the South West over an 18 month period.

I thank everyone who has taken the time to attend workshops, read draft reports and provide feedback. Your input has enabled the Water Corporation to prepare a comprehensive report guided by local knowledge and needs.

Hon. Mia Davies
Minister for Water

Acknowledgements

Water Corporation acknowledges the valuable contribution made by the South West community and stakeholders.

Particular thanks go to the Water Reference Panel, Department of Water, Busselton Water, Aqwest and local government authorities for their ongoing contributions and engagement with the project.

The Water Reference Panel for this project provided independent advice on future trends, planning assumptions, sustainability assessments, and water source proposals.

The panel members are: Mr Barry Oates, Secretary/Treasurer, GeoCatch; Dr Don McFarlane, Principal Research Scientist, CSIRO; Dr John Marsden, Director, Marsden Jacobs and Associates; Dr Libby Mattiske, Managing Director, Mattiske Consulting; and Mr Adam Lovell, Executive Director, Water Services Association of Australia.

Thanks also go to the catchment councils, businesses, farmers' markets, and community resource and visitor centres for providing venues and support for our community information displays and workshops.

The community attitudes survey for this project was conducted independently by the research company Ipsos. Both surveys conducted as part of this project were analysed and reported by Ipsos.

The community workshops held in Busselton and Nannup were facilitated by Joel Levin from Aha! Consulting.

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Community Engagement

Community input was key to the *Water Forever: South West* report, allowing communities and stakeholders to shape the future of our water supply in the region.

The options you see in this report consider environmental, social and economic factors. Local knowledge helped us to understand the impact this precious resource has on your lifestyle and livelihood, and helped us arrive at the final options.

The community engagement process

Comment and feedback from community members was sought through a range of channels from August 2013 to February 2014.

Channels included:

- Direct mail
- Newsletter updates
- Website updates
- Stakeholder briefings
- Community information displays, workshops and forums held across the region
- Research surveys including a statistically representative phone survey of randomly selected Water Corporation customers in the South West, and a public survey available at information displays and our website.

All engagement activities were supported by a suite of information materials.

"The Water Corporation is to be commended on the initiative to undertake the South West planning study to ensure that reliable drinking water supplies are maintained in a sustainable way" (Stakeholder comment)

Public comment period

The draft report was released for an eight week comment period from 21 October to 16 December 2014. During this time, the web page was viewed 612 times with the executive summary downloaded 119 times and the full report 156 times.

Water Corporation received 21 written submissions from the community and stakeholders in response to the draft report.

This included comments from:

- Shires of Augusta-Margaret River, Manjimup, Bridgetown-Greenbushes, Donnybrook-Balingup, Capel, Collie and Harvey;
- City of Bunbury;
- Department of Parks and Wildlife;
- Department of Planning;
- Department of Water;
- Bunbury Wellington Economic Alliance;
- South West Development Commission;
- Urban Development Institute of Australia (WA)

What you told us

During the consultation process for the *Water Forever: South West* report, we learned that stakeholders supported the long term planning approach of a 50 year water supply plan. There was general agreement with the drying climate and its impact on water availability in the South West, with particular concern on the sustainability of groundwater resources and the impacts of urban water demands on the environment.

Community expressed their concern that groundwater from the South West Yarragadee Aquifer would be used to supply the Perth metropolitan area and highlighted the need to address broader issues with regard to the control, access and management of groundwater and surface water resources.

The majority of the community endorsed approaches to reduce water use, increase water recycling and progress new water sources. There were many comments supporting the use of treated recycled water for drinking and irrigation of public open space, industry, agriculture and greywater recycling in the home.

"One of the most significant ways to make water efficiency gains is through the development of water efficiency measures in new growth areas before the development is built" (Industry comment)

Micro-desalination plants were also supported provided renewable energy could be utilised. Community members supported loan and funding incentives for home rainwater tanks and water efficiency measures, however there was debate on how achievable the water efficiency targets set in the draft report will be given the significant reductions already made.

There was also considerable variation across the region covering water pricing, development of new surface water dams and use of groundwater.

The top 10 issues from stakeholder consultation

- Acceptance of drying climate
- Against use of South West Yarragadee groundwater for Perth
- Support for rainwater tanks
- Support for water efficient measures, particularly new developments
- Support for "fit-for-purpose" recycling
- Support for micro-desalination plants with use of renewable energy
- Support for surface water and groundwater replenishment
- Concern for limited recreational use in drinking water catchments
- Concern for management of groundwater resources from all users
- Water pricing to reflect the value of water

"It is necessary residents understand the impacts by increasing pricing. There is greater encouragement to use water resources with respect" (Industry comment)

"The level of growth and development being planned for in the South West region is significant and the ability to accommodate this development and meet the rising water demand will be a vital component in the success of this new growth to the region" (Stakeholder comment)

"Recycled water for drinking has been used successfully overseas for years – Australia needs to catch up" (Stakeholder feedback)

For more information, see the Community Engagement Report at watercorporation.com.au/waterforeversw

Executive Summary

Water Corporation has undertaken a planning study of water needs and sources for our South West customers for the next 50 years to ensure that reliable drinking water supplies are maintained in a sustainable way.

The planning takes into account a number of pressing issues, principally the drying climate, population growth, changes in the way water services are delivered, and changes in technology and lifestyles.

We recognise the transition to a climate resilient future will be a shared journey. Extensive stakeholder and community consultation has already taken place, including a community attitudes survey. The community will continue to have an important role, particularly with improving efforts to reduce water use and adopting a new mindset for waterwise behaviours.

We are working in partnership with all community sectors, including households, business, industry, agriculture, schools, all tiers of government, and academic and research institutions.

The most likely scenario for the longer term is that there will be less rainfall, so we need to be prepared. We are also expecting hotter weather and more droughts.

Limited water resources will be exacerbated by growing demand from industry and agriculture.

The challenge for us is to provide drinking water:

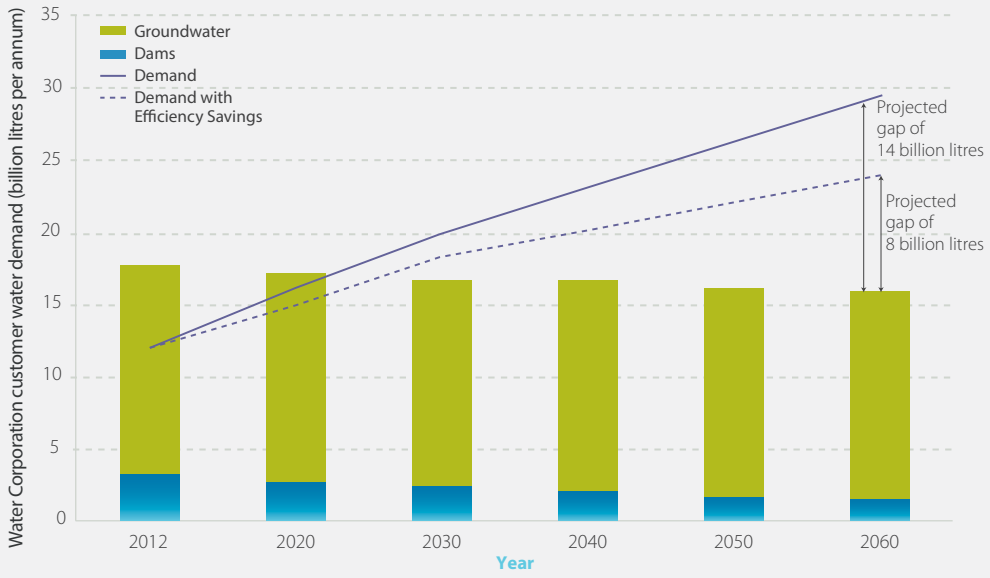
- in an even drier climate
- with twice as many people, and
- with less environmental impact.

The planning study covers the 31 South West towns we currently supply with water sourced from groundwater and surface water, and includes wastewater services in Bunbury and Busselton. It does not include areas where Aqwest and Busselton Water provide water services.

Over the next 50 years, water demand in the study area may more than double from 12 billion per year to nearly 30 billion litres (see Figure 1). To meet this challenge we have adopted a portfolio approach that focuses on climate resilience by:

- reducing water use
- increasing water recycling, and
- developing new water sources.

Figure 1 Current Water Corporation water supply and projected demand for Water Corporation customers



Excludes areas supplied by Aqwest and Busselton Water.

Figure 2 Water Forever: South West planning study area

The drying climate

It is now well established that rainfall in the South West of Western Australia has decreased as part of the drying climate. This has been happening since the 1970s and has greatly reduced streamflows into dams and lowered regional groundwater levels.

Based on work completed by the Commonwealth Scientific Investigation and Research Organisation (CSIRO) and the Bureau of Meteorology, this trend is expected to continue over the next 50 years. This will have a significant effect on water availability for all sectors, including households, business and industry, local government, mining and agriculture, as well as the environment.

The CSIRO South West Sustainable Yields Project (2009) outlined climate projections and the associated impact on yields for both surface water and groundwater resources to 2030. The results highlight that the impact on water resources varies with location.

The CSIRO groundwater modelling to 2030 has shown that areas are less affected by a drying climate where each winter's rainfall is able to refill shallow unconfined aquifers. This is most common in sandy areas with high water tables and no perennial vegetation. Parts of the Swan and Scott Coastal Plain meet this requirement. It also found that for an area south of Bunbury, the water table under the Swan Coastal Plain remains stable under all climate scenarios.

Much of the Blackwood plateau is under native woodland and has deeper and often clayey soils and, as a result of a drier climate, there will be a greater impact on groundwater levels. For example, CSIRO estimates groundwater flows into the Blackwood River may decrease by between 20 and 30 per cent under a drier climate.

Public drinking water supply is not the only area that will be impacted by a drier climate. Our customers use 7 per cent of surface water and 7 per cent of groundwater in the South West; so other users, such as agriculture, mining, industry and local governments, will need to develop discrete strategies.

A warmer, drier climate may also increase the frequency and intensity of bushfires. Higher temperatures and reduced soil moisture could increase the challenge of undertaking controlled burns for fuel reduction.

Our natural environment will have to adapt to a drier climate. The drying climate will increase stress on native vegetation and in turn its susceptibility to other pests. For example, during the dry winter of 2010, vegetation deaths were recorded even in drought tolerant species of the northern jarrah forests.

For *Water Forever: South West* we used the CSIRO's 'dry climate' projections and considered if the water supply options were rainfall dependent or not.

Regional setting

The South West region is internationally recognised as a biodiversity 'hot spot' and highly valued for its natural beauty from forests to Geographe Bay. It has the most diversified economy of all regions in WA with some of its key industries including agriculture, viticulture, mining, tourism and fishing. The region's wineries produce over 20 per cent of Australia's premium wine.

Population growth across the South West region varies but there has been strong growth in the City of Bunbury, City of Busselton and the Shires of Harvey, Capel, Dardanup and Augusta-Margaret River.

The most significant areas for future growth are along the coastal strip from north of Bunbury to Dunsborough. These areas are currently supplied from groundwater and already account for over 65 per cent of water demand in the study area.

We expect capacity of the Capel and Dalyellup schemes will need to be increased in about five years depending on population growth and water use efficiency, followed by Eaton-Australind around 2030.

In contrast, inland towns represent a significantly smaller proportion of the region's population and have not experienced the same rapid urbanisation. These towns are largely supplied by surface water dams and the recent drying climate has triggered ongoing investment in water supply systems to provide water security.

Schemes like the Warren-Blackwood Regional Water Supply Scheme make up less than 15 per cent of the total water demand of Water Corporation customers in the South West. Between now and 2030, water demand in these areas is not expected to grow rapidly as a result of population growth — the trigger for a new water source is likely to be the result of a series of several dry winters.

Creating a portfolio of water options

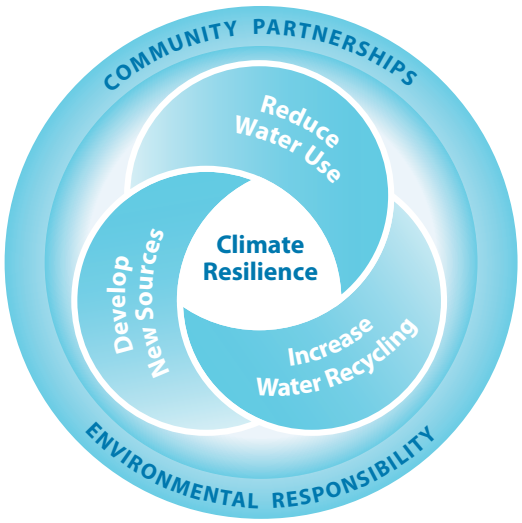
The timing of new sources is dependent on many factors including population growth, water usage, reliability of supply, and rainfall.

Based on past experience, we know that developing a portfolio of options is a robust approach that gives us the flexibility to adapt to unforseen changes.

We have undertaken a sustainability assessment of 80 options which could help meet future water demand. The results from this assessment have been considered and incorporated into the options for this final report.

This study has also highlighted the geographical variation of different options across the South West. For example, rainwater tanks are more effective in areas of high rainfall, groundwater is only available in certain areas, and large-scale water recycling is more viable in areas near Bunbury and Busselton where large volumes of wastewater are available.

We have grouped the report into the key areas of reducing water use, increasing water recycling and developing new sources, and all three areas will be required to achieve climate resilience. Figure 3 shows the location of potential water supply and water recycling options, as well as the groundwater sub-areas.



Reduce water use

Over the last five years, our customers in the South West have reduced their water use by 15 per cent, which has allowed for the total water demand to remain generally constant despite a growing population.

However, water use efficiency varies between towns and, while it has been improving, there is scope for additional water savings to be made compared to other regions around the state.

To achieve future water security, we propose to extend this figure and set a target of 25 per cent reduction in water use per person to 2030. This can be achieved through targeted application of established programs (for example, Waterwise programs and sprinkler rosters), and also by continuing to implement technologies such as data logging and leak detection.

Community support is vital to achieving water use efficiency improvements.

Increase water recycling

About 28 per cent of the South West region's treated wastewater is recycled each year. This recycled water is used to irrigate woodlots, golf courses and public open space.

We provide free recycled water 'at the gate' of our wastewater treatment plants for schemes which benefit the community, for example watering on public open space. However, the user is responsible for building the necessary infrastructure to transfer and use this recycled water.

Figure 3 Potential water source options for South West towns

Town

Water supplied by Independent Water Utility

Water Dam

Water Forever Study Area

Groundwater sub-area

Bunbury

Busselton-Capel

Blackwood

Potential water supply options

Catchment Management

Water Carting

Micro Seawater Desalination

Potential Groundwater Source

Potential recycling options

Golf Course/Public Open Space

Woodlot/Orchard

Groundwater Replenishment/ Managed Aquifer Recharge

Managed Aquifer Recharge (Saltwater Barrier)

As traditional sources for drinking water supplies come under increasing pressure, water recycling will become a more viable and cost effective option.

Groundwater replenishment has been included in the portfolio of options as a climate independent source for areas near Bunbury, Busselton-Dunsborough and Margaret River. This process is where treated wastewater is further treated to drinking water standards and recharged into a groundwater system. The water is stored in the aquifer and taken out some time later for further treatment and supply to a drinking water system.

Some other water recycling options included in this final report do not necessarily increase the amount of drinking water available, while others would be dependent on factors such as development, legislation and funding.

Develop new sources

In the South West, water is sourced from dams and groundwater, and supplied locally or through an integrated scheme.

The options presented in this final report are for local sources to supply local towns or areas and the State Government's position is that the South West Yarragadee aquifer is for local use only. We have no plans to pump water from the South West Yarragadee Aquifer to Perth and it is not a potential option being considered as part of this project.

The section on developing new sources has an overall summary of options and then focuses on five sub-regional areas: towns on the Swan Coastal Plain, Collie, Margaret River-Augusta, Warren-Blackwood, and Pemberton-Northcliffe-Quinninup. A snapshot of water demand in these areas is provided in Table 1.

The three main water source options presented in the final report are for surface water, groundwater and seawater desalination.

Surface water sources (dams) remain important east of the Darling Scarp where there is limited groundwater. While dams will continue to play a role as a water source for some locations, we expect they will become less reliable and increasingly used for storage and in conjunction with other sources.

Surface water schemes in the Great Southern Towns Water Supply scheme and the Warren-Blackwood Regional Water Supply Scheme are more susceptible to a series of dry winters than towns supplied with groundwater.

Our initial community engagement indicated that there is community support for surface water sources, and we have included an additional four in this final report — Gregory Brook, Nannup Brook, Camp Creek and Northcliffe Dam.

However, comment on the draft report indicated some stakeholders are concerned about new dams and the associated limitations on recreational activity.

Groundwater is a major water source for the South West and we have included several options to expand groundwater where it is available.

The Department of Water (DoW) sets limits on the amount of groundwater that can be abstracted by various users through its allocation plan. It has reserved about 9 per cent for future public water supplies in the South West region. The allocation for our customers is 14.7 billion litres per year, which is about 7 per cent of the total amount of groundwater made available by DoW.

The DoW's South West allocation plan reserves groundwater to meet town water demand to 2034.

As a result of strong water efficiency gains by customers, the existing public groundwater reserve is estimated to be able to meet regional demands beyond this timeframe if groundwater is available and allocations are not reduced.

For seawater desalination, we have included options for micro desalination plants on the west coast, south coast and at Windy Harbour, and also an option for water from the Southern Seawater Desalination Plant near Binningup to be used to supplement water supply to areas such as Eaton-Australind if required.

Other new source options include groundwater replenishment, reducing evaporation from dams, catchment management, groundwater trading and bulk water purchase.

Integrating water supply schemes

There are already several integrated schemes in the South West region, however, the region generally is characterised by multiple locations and water sources, with little inter-connection.

While there are benefits to integrating water supplies, constructing pipelines is capital intensive and there can be substantial operational costs because of the distances the water needs to be pumped.

We looked at several options to inter-connect towns in the South West and assessed these against a 50-year timeframe and under various growth, climate and water use efficiency scenarios.

The volume of water being moved between the water sources significantly influences the cost-effectiveness of integration options. Where there is a large population, high demand for water and scarce local sources, an integrated scheme may be the most cost-effective option.

The options presented in this final report (see pages 68–71) are to supplement the Great Southern Towns Water Supply Scheme, expand the Warren-Blackwood Regional Water Supply Scheme, and to connect Pemberton, Manjimup Dam, Northcliffe and Quinninup.

We also assessed a scenario that integrates climate independent sources such as micro seawater desalination plants and groundwater replenishment schemes. With the cost estimated to be $1.6 billion, there are many local water sources and water efficiency measures that could be implemented before a fully integrated system would be justified.

Environmental responsibility

Using less water is a significant step towards climate resilience and lessening our physical impact on the environment.

Some other ways we are working to improve environmental outcomes include:

- investing in renewable energy such as wind, wave, solar and biomass
- becoming more energy efficient
- caring for bushland under our protection
- monitoring ocean discharge to ensure it is an appropriate quality
- monitoring vegetation and groundwater levels,
- promoting research in water sensitive urban design, and
- protecting the purity of public drinking water sources through drinking water catchment protection.

Community partnerships

To deal with the challenges ahead, we all will need to change the way we use water.

We are committed to continuously engaging with Western Australians on water issues that affect them. This includes ensuring the public can have input into plans like *Water Forever: South West*, educating the community on how to reduce water use and engaging with local communities about new and improved water or wastewater infrastructure.

Table 1 Regional overview for towns serviced by Water Corporation

	Number of water connections	Annual per person water use	Current water supply capacity*	Current water use	Estimated demand at 2060
		(thousand litres per year)		(million litres per year)	
Towns on the Swan Coastal Plain					
Eaton, Australind, Burekup, Roelands and Brunswick Junction	11,200	161	6,600	4390	12,160
Dunsborough – Yallingup Supplemented by bulk water supply from Busselton Water	4,600	171	1,450	1420	3680
Dalyellup	2,200	180	1,170	1080	3120
Donnybrook	1,100	146	450	360	820
Capel	930	145	400	300	950
Boyanup	390	190	325	160	420
Peppermint Grove Beach	340	117	150	100	180
Dardanup	200	123	75	50	140
Warren-Blackwood area					
Bridgetown, Greenbushes, Hester, Balingup, Kirup, Mullalyup and Boyup Brook	2,500	116	1,450	620	1240
Nannup	320	209	1,240	150	220
Manjimup	2,300	144	515	720	910
Margaret River-Augusta area					
Margaret River, Cowaramup, Prevelly, Gnarabup	4,400	126	2,000	1080	3180
Augusta	1,100	113	320	265	480
Collie area					
Collie and Allanson	3,900	133	15,500	1100	1780
Pemberton – Northcliffe – Quinninup area					
Pemberton	440	162	250	150	170
Northcliffe and Quinninup	210	71	Water carted	28	60
Total				12,000	29,500

Note: numbers have been rounded and the 'Estimated demand at 2060' does not include further water use efficiency gains

* Current supply capacity includes surface water yield and water treatment plant capacity.

South West regional overview

The South West region covers approximately 24,000 km^2, two-thirds of which is either state forest, national or regional parks. The rest is made up of land for agriculture and rural activities (about 6,000 km^2) and for industrial and urban development (about 2,000 km^2).

The South West has the most diversified economy of all regions in the state.[1] Mining, construction and manufacturing are the main economic contributors, while about 15,400 small and retail businesses provide a sound employment base for the region.

Renowned for its agriculture, the region's dairy farming produces around 89 per cent of the total value of Western Australia's milk. Other agricultural products include vegetables, cattle, fruit and premium wine grapes.

Growth rates in the cities of Bunbury and Busselton have been amongst the highest in regional Western Australia and these areas are likely to continue to expand. In anticipation of future growth, the towns of Collie, Margaret River and Manjimup have been identified as SuperTowns under the WA Government's Royalties for Regions program.

Tourism remains a key economic driver for the South West and Tourism WA estimates approximately 1.7 million overnight visitors to the region each year.[2] More than 80 per cent are from within the state, highlighting the importance and appreciation of the South West by all Western Australians. Its popularity is also reflected in water use patterns, which show substantial increases over peak tourist seasons.

The South West region is internationally recognised as a biodiversity 'hot spot' and highly valued for its natural beauty. There are a range of internationally and nationally recognised environments in the *Water Forever: South West* study area including sites designated as Wetlands of International Importance under the Ramsar Convention, threatened species and over 24 national parks. Many of the environments are dependent on surface water and/or groundwater.

Total water use

The Department of *Water's South West Regional Water Plan: 2010–2030* covers surface water and groundwater resources, and assesses current and future water availability and demand. It identifies that there is more than 800 billion litres of water available each year in the South West region, 75 per cent of which comes from surface water sources. The Department estimates that the demand for water in the South West will increase from the current level of around 500 billion litres to 700 billion litres by 2030 and availability could decrease by 25 per cent as a result of drying climate.

The plan also outlines water demand by different sectors (see Table 2). However, land management practices also impact on water availability, such as plantation forestry, which makes up an estimated 16 per cent of total water use.

Land management practices impact water use and these will become more critical under a drier climate. The CSIRO's South West Sustainable Yields Project highlighted the importance of vegetation in determining the amount of runoff and water that is recharged into groundwater under a drying climate. It indicated that actively managing vegetation so that it is better adapted to a future climate could improve both ecological and hydrological values compared with the 'do nothing different' scenario. As such, the Department of Parks and Wildlife has a key role in land management of state forest, national and regional parks.

Recognising the links between land and water management will be essential to prepare for a drier climate.

1. South West Development Commission website, http:swdc.wa.gov.au/industries.aspx
2. Source: Tourism Western Australia Overnight Visitor Fact Sheets, YE 2007-2013

Table 2 Estimated water distribution in the South West by sector

Sector category	Total water demand (billion litres)	Percentage of total allocation
Agriculture	146.4	28.3 %
Irrigation Scheme Supply	120.8	23.3 %
Plantation Forestry*	82.0	15.9 %
Mining	77.4	15.0 %
Public Water Scheme Supply	34.3	6.6 %
Industry and Power Generation	30.0	5.8 %
Private Garden Bores*	12.0	2.3 %
Parks, Gardens and Recreation	6.3	1.2 %
Stock and Domestic	5.6	1.1 %
Commercial and Institutional	2.7	0.5 %
Other	0.4	0.1 %
Total	517.3	100 %

*Source: Department of Water database, 2014, except for categories with * which are from the South West Regional Water Plan (2010).*

Projected drinking water demand

Our future projections of water demand are based on historical growth rates and the Department of Planning's WA Tomorrow projections. Town planning schemes such as the *Greater Bunbury Structure Plan* provide additional information on growth projections.

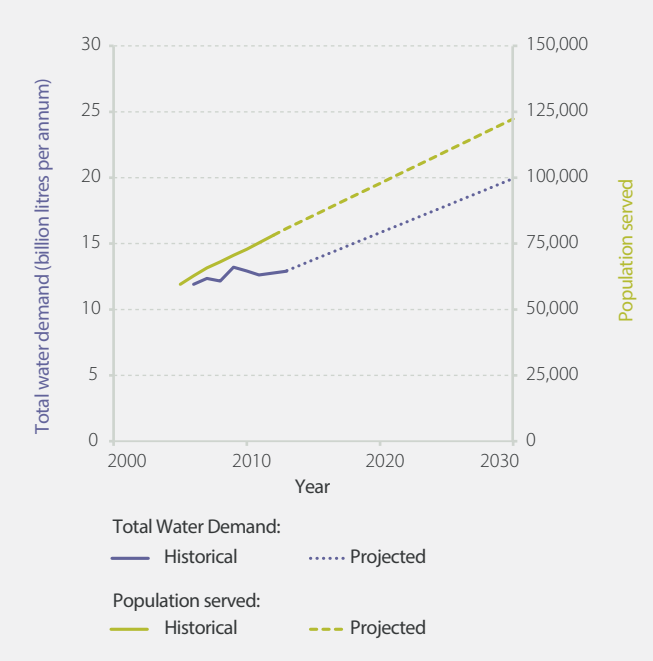
Over the last five years, the number of customers has steadily increased while, due to improved water efficiency, total water demand has remained relatively constant.

The projected growth in Water Corporation customers for the South West and the total projected growth in water demand to 2030 are shown in Figure 4. Over the next 50 years, the total water demand may increase from 12 billion litres to approximately 20 billion litres per year by 2030 and 30 billion litres by 2060 based on recent water use rates.

Over 65 per cent of our water demand occurs on the Swan Coastal Plain from Australind to Dunsborough. This is expected to increase.

We will continue to closely monitor water usage rates and projections to adopt strategies as required.

Figure 4 Historical and projected growth in water demand and Water Corporation customers



Water management in the South West

Western Australia's water resources are managed by the Department of Water.

The Department of Water is responsible for granting licences to take water and ensuring licence conditions are met. It sets water allocation limits and uses water allocation plans to guide licensing. The Department undertakes regional monitoring of water resources and monitors performance against the criteria defined in allocation plans.

There are currently about 3,500 water licences in the South West for both surface and groundwater resources. Of these, there are 2,500 licences for South West groundwater areas, 2,100 of which are for less than 50 million litres per year. There are also a number of small-scale stock and domestic users who do not require licences.

Water Corporation applies for surface water and groundwater licences from the Department of Water.

The Department of Water has been progressively requiring meters for those users who are in an environmentally sensitive area, or who use more than 50 million litres per year.

The Department has a strong focus on sustainable water use and requires increased monitoring from all high risk water users. The Department has also increased compliance and enforcement activities in this area.

We support the Department's focus on regional monitoring of data and increased monitoring of all water uses. Having access to as much accurate and up-to-date information as possible will be necessary to help understand the impacts of a drier climate. Any future changes to the existing water resource legislation should also facilitate management of water resources under a drier climate.

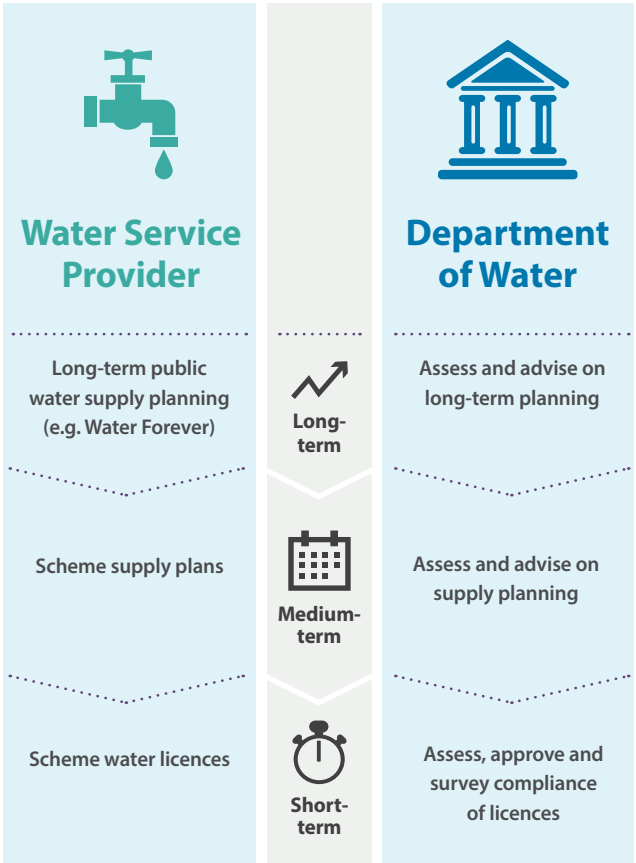
There are three water utilities in the South West. Bunbury and Busselton are supplied with drinking water by the service providers: Aqwest and Busselton Water. The water utilities work with the Department of Water in undertaking water supply planning (Figure 5).

Within the South-West Water Corporation supplies drinking water to 31 regional towns and areas, and provides wastewater services at 16 locations (including Bunbury and Busselton), servicing approximately 34,000 properties and 84,000 customers.

The *Water Services Act 2012* and associated *Water Corporations Act 2013* ensure all three water utilities in the South West operate on a level playing field and facilitate options such as bulk water supply agreements or water transfers (refer page 40-41). The Minister for Water is the owner of all three utilities.

In 2010, the Economic Regulation Authority investigated the option to merge the three utilities, but the State Government decided to retain three independent utilities.

Figure 5 Roles of water service providers and Department of Water



Planning study approach

The *Water Forever: South West* planning study began in 2013 and the project was officially launched in Margaret River on 16 August 2013.

Planning assumptions

Because we cannot know precisely what will happen over the next 50 years, we consider a number of scenarios and factors when assessing the future water needs of the region, such as:

- climate and source availability under medium to low rainfall projections
- current growth rates, including sensitivity analysis in high growth towns and SuperTowns, and
- current water use per person and the capacity for improving water use efficiency.

These scenarios support an approach where we can consider a range of initiatives for new sources, water use efficiency and water recycling, rather than focussing only on one new water source.

The value of each option will be adjusted over time as knowledge and conditions change. For example, groundwater allocations may reduce overtime or a groundwater option could become more manageable with additional detailed information.

There also is a balance between providing spare capacity to reduce the chance of water restrictions, and the cost of providing that spare capacity. We can provide water supply security by building new sources (or reducing demand) but we can also do this by being ready to deliver new sources (or reducing demand) in a short period of time.

Sustainability assessment

The need to deliver sustainable outcomes in planning for water services underpins *Water Forever: South West*. We selected a multi-criteria analysis as the tool to undertake a comprehensive assessment of 80 options for new sources, water recycling and water use efficiency.

The assessment is based on 15 sustainability criteria, which are evenly split between environment, social and economic pillars. This integrated approach ensures that options to reduce drinking water demand (such as water use efficiency initiatives) are compared with options that increase supply (such as new water sources) on the same basis.

Each option is rated with a sustainability score of between 0 (least sustainable) to 4 (most sustainable) against each of the 15 criteria, giving a total sustainability score of between 0 (least sustainable) and 60 (most sustainable).

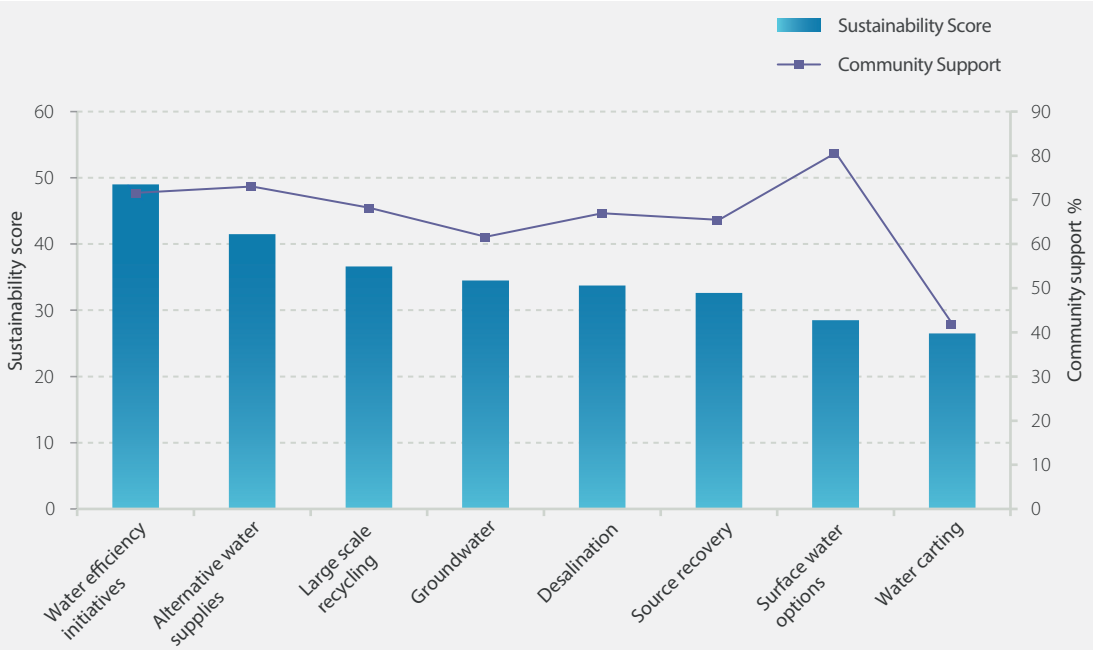
Figure 6 shows the outcomes of the sustainability assessment compared to the level of community support.

The outcomes from the sustainability assessment have been used to develop this report. The results are closely aligned with the community's support to reduce water use and increase water recycling.

More details are provided in the Sustainability Report, which is available at watercorporation.com.au/waterforeversw.

Figure 6 shows the average sustainability scores and community support for each suite of options. The community preference generally corresponds with the sustainability results for the options, except for surface water options (dams), where the level of community support is disproportionate to the sustainability rating.

Figure 6 Sustainability assessment score and community support for potential options



Water Reference Panel

The Water Reference Panel has an integral role and brings a broad range of knowledge and expertise to this planning study. It provides independent advice on future trends, planning assumptions, sustainability assessments and water source proposals. The panel have endorsed this final report.

Pictured above are (left to right): Ashley Vincent, Water Corporation, with Water Reference Panel members Barry Oates (Chair), Adam Lovell, Don McFarlane, Libby Mattiske and John Marsden.

Note from Chair

The members of the *Water Forever: South West* Water Reference Panel have extensive experience in water resource management in the South West and all over Australia. They bring to this project expertise in the following areas:

- Water resource planning including development of a portfolio approach to manage climate risks
- Adaptation to a drying climate
- Decision making in uncertainty
- Cost benefit analysis
- Sustainability assessment
- Ecological and environmental assessment
- Catchment management
- Wastewater recycling and assessment
- Groundwater and hydrogeology within the south west
- Experience in operation and management of water utilities

The *Water Forever: South West* Water Reference Panel undertook a thorough review of the planning process undertaken by Water Corporation including:

- Planning assumptions covering both supply and demand
- Climate challenges and scenarios investigated
- Sustainability assessment framework
- Identification of future trends and
- Reviewing comments received during community and stakeholder consultation process

With the drying climate in the South West and growing population it is important to have a robust and long term water supply plan. As panel members we feel as though we have been able to add value to the process. We bring different views and broader perspectives which has resulted in a stronger and well-rounded planning project.

The panel recognises that many of the future water challenges in the South West extend beyond town water supplies and this was also reflected in many stakeholder submissions. Reduced rainfall and water availability will impact native vegetation and new approaches to land management will be required to help manage the transition. Water efficiency improvements will be required by all water users. Agricultural activities will also need to adapt to a drier climate. Wellington Dam provides a unique water source in the South West to support some agricultural areas and industry however elevated salinity is limiting its potential and will need to be careful management into the future. It is clear that meeting the challenges of the future will require increased co-operation and collaboration both across government and within the community.

The challenges ahead are significant however the portfolio approach adopted in *Water Forever: South West* allows flexibility to adapt to changing conditions. The South West is blessed with a number of options including water use efficiency gains through planning or technology improvements, coastal desalination plants, local groundwater and increased recycling – particular groundwater replenishment which could be a future water source. Water Forever: South West provides a framework so over the next 50 years it will be possible to work with the community to implement the best option at the time it is needed.

The panel commends *Water Forever: South West* to the Water Corporation for publication.

Mr Barry Oates
Chair – Water Reference Panel

Reduce water use

We propose a target for our South West customers to reduce water use by 25 per cent by 2030.

Community support for water use efficiency is very strong and many people already do their bit to save water. For example, more than 80 per cent of customers in the South West adhere to the sprinkler restrictions and 38 per cent currently recycle their laundry water.

Since 2008, the average per person water use in South West towns that we supply has decreased from 173,000 litres per person to 150,000 litres per person.

Community members want to see more water use efficiency not only for residential users, but for businesses, industry and irrigating public open space. While we supply around 1.8 billion litres of water to business and industry, our customers are mostly residential, accounting for 80 per cent of the water we supply in the South West.

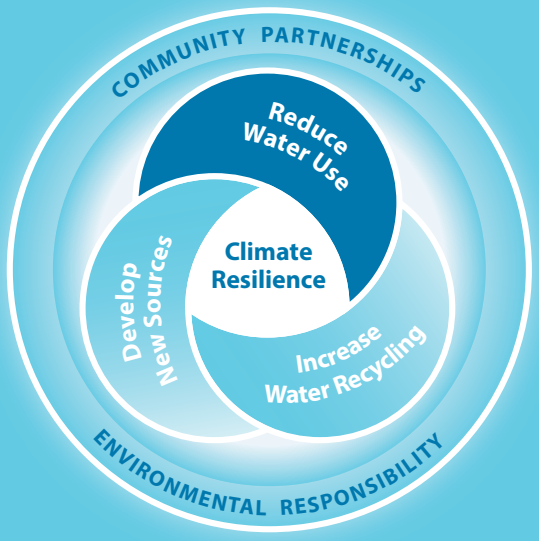
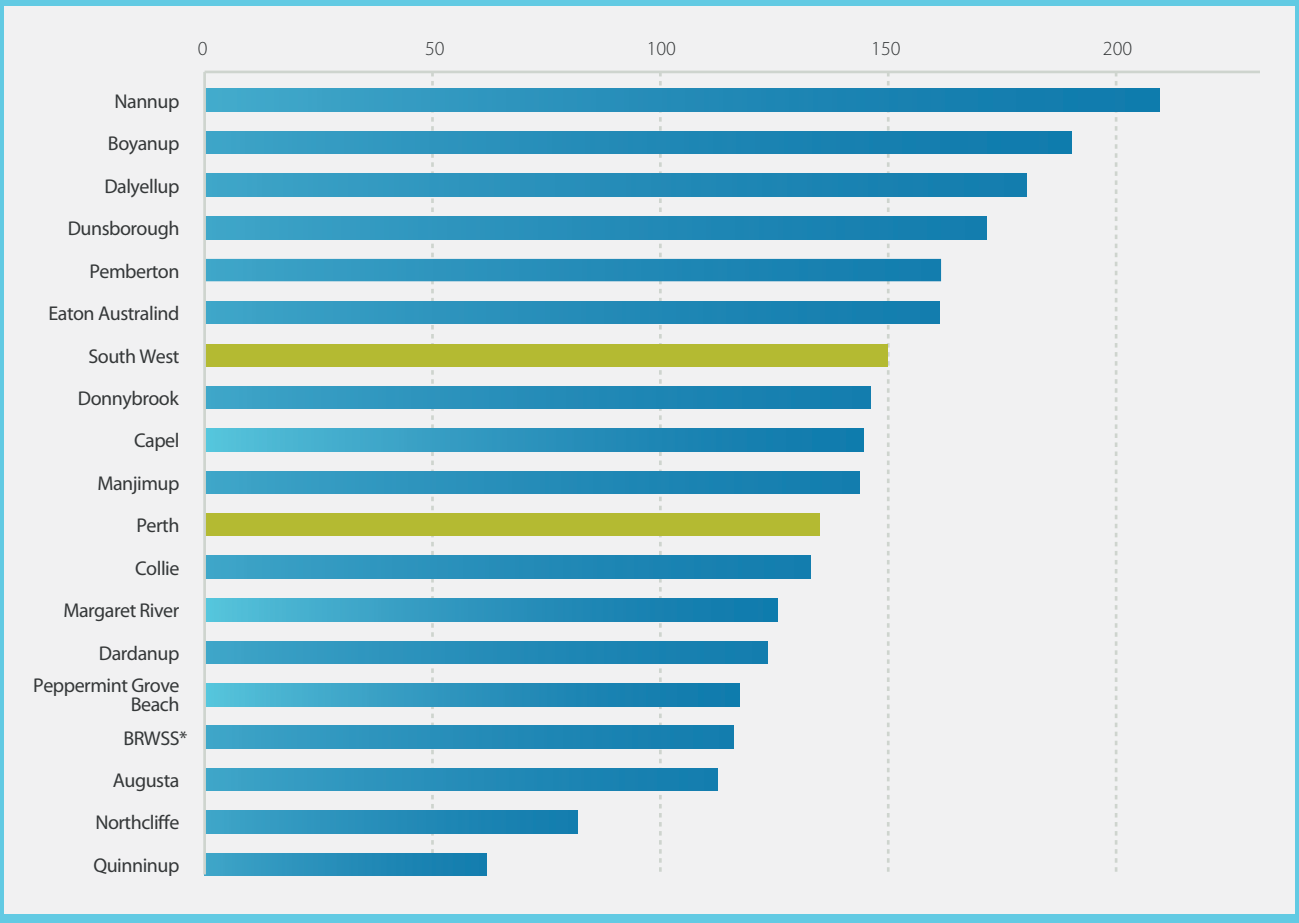


Figure 7 Annual scheme water use per person by town (thousand litres per person) for Water Corporation customers



Note: Includes residential, business, commercial customers and non-revenue water for Water Corporation Schemes only.
** BRWSS is the Bridgetown Regional Water Supply Scheme.*

While the overall water use for the region has decreased, the average residential consumption is still high in some towns, and compared to surrounding areas. For example, water use is higher along the Swan Coastal Plain and in newer suburbs such as Dalyellup, where water is needed to establish new gardens and which tend to have a higher proportion of families.

The most effective way for us to make significant water use efficiency gains is by targeting these high use areas, as well as future growth areas. For example, in the major urban expansion planned east of Eaton (c. 28,000 new homes) and in Waterloo (1500 Ha of industrial development planned) that may double the existing population of Greater Bunbury.

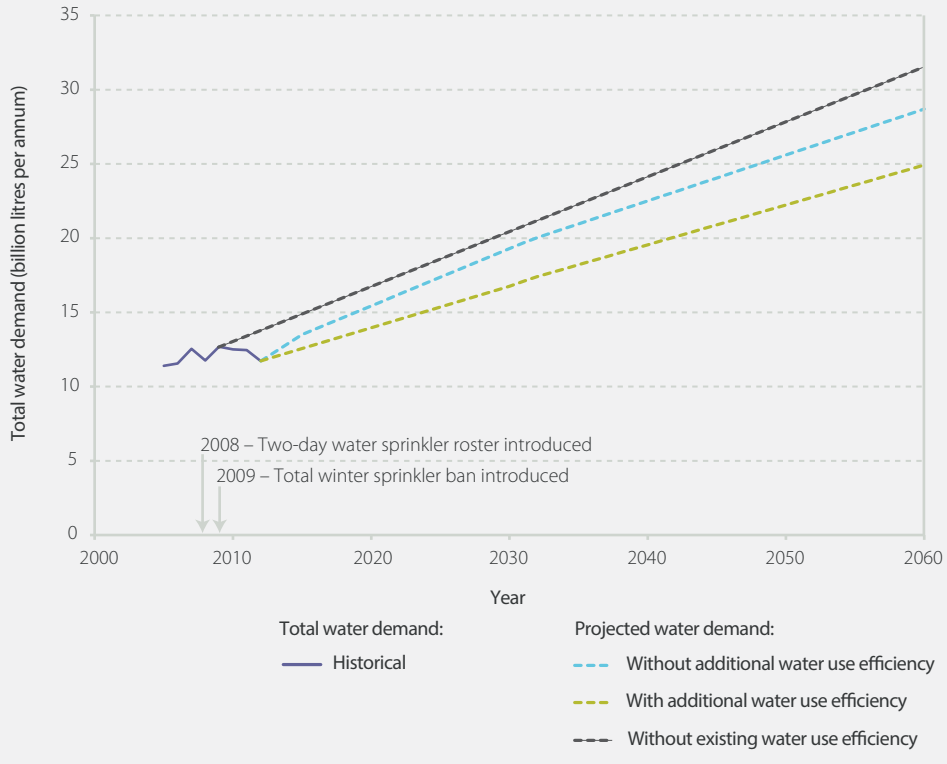
Embedding water efficient design into all new urban developments is likely to have a significant impact if implemented. Other water use efficiency savings could be achieved through urban infill, technology advances or additional regulations.

We support and encourage initiatives, and recognise the need to work in partnership with other agencies, especially where we do not have the authority to implement them.

Table 3 Estimated water savings with current, additional and extreme water efficiency savings for 2030 and 2060

	Estimated water savings by 2030 (billion litres per year)	Estimated water savings by 2060 (billion litres per year)
Current water efficiency savings maintained	2.8	4.0
Additional water efficiency savings achieved	2.5	3.8
Extreme water efficiency savings	2.2	5.0

Figure 8 Total annual water demand for Water Corporation customers for the South West



What has been achieved?

In the last decade, the introduction of a range of regulations, such as the development of permanent water efficiency measures, has helped to encourage water use efficiencies[3]. At the same time, we have implemented a range of programs to influence and encourage water efficient behaviour.

It takes time to adjust to using less water. For example, sprinkler restrictions need to be applied over several years and in coordination with awareness campaigns to change behaviour. Water efficiency measures also work best when coupled with water source development options as part of an integrated plan.

At the household level, we continue to work towards a residential water use target of 100,000 litres per person per year by 2030, and our greatest water savings have been made through:

- working with customers one-on-one to show how they can save water
- supporting technological advancements in water efficient appliances
- providing information and encouragement to help households and land developers plant waterwise gardens more suited to a drier climate, and
- working with land planning agencies, local governments, land developers and builders to increase the uptake of water sensitive urban design principles.

We have also worked with industry and business customers on targeted programs to reduce their water use.

We will continue to work on these and other measures into the future, with a particular focus on high growth areas.

Water use efficiency in the home

To date, we have delivered residential behaviour change and retrofit programs to seven schemes across the South West. The WaterSmart and H_2omeSmart programs were targeted to towns which had immediate water needs, including:

Collie; Dalyellup; Bridgetown, Balingup, Boyup Brook, Greenbushes, Hester, Nannup, Kirup and Mullalyup; Manjimup; Margaret River; Northcliffe; and Quinninup.

We worked with households over six months to set targets, provide feedback on their water use, and help to identify ways they could conserve water.

The water savings have been achieved by adopting simple actions such as reducing shower times, installing water efficient showerheads, reducing reticulation times and fixing leaks. On average, participating households reduced their water use by about 10 per cent.

This has been effective to date and we will continue to use this approach into the future.

Water use efficiency in the garden

In Western Australia, approximately 40 per cent of drinking (scheme) water is used outdoors[4]. This is partly due to large blocks, hotter summers and free draining sands that do not retain moisture.

The impact of our drier winters and hotter summers can also be seen in watering patterns. Across Australia, 36 per cent of households[5] rely only on rainfall to water their gardens in comparison to just nine per cent in WA. The use of reticulation systems in the state is also significantly higher — approximately 55 per cent of WA households have reticulation, compared with the Australian average of 12.5 per cent.

While over 86 per cent of South West customers use mulch in their garden (significantly above the state average of 52 per cent), households can save more by improving the way gardens are landscaped. For example:

- conditioning the soil before planting to improve moisture retention
- replacing non-native plants with native plants or other species suitable for a dry climate
- minimising the amount of lawn in the garden by replacing it with waterwise plants or ground cover, and
- using larger shrubs and trees to provide shaded areas to conserve soil moisture.

Waterwise Towns Program

Collie is currently taking part in the Waterwise Towns program. Customers are receiving water efficient coaching and have access to waterwise products and services such as water efficient showerheads.

3. For example, the current two-day sprinkler roster, and total winter sprinkler ban.
4. Perth Water Domestic Water Use study
5. ABS Water Use Conservation Statistics 2013

Rainwater tanks

Household rainwater tanks often provide water for outdoor uses such as garden watering, however, greater savings can be made by plumbing the tank for internal non-drinking water uses such as toilet flushing and clothes washing. This is because indoor uses such as toilet flushing occur all year round and increase the use of the tank over winter. In contrast, most outdoor uses happen over summer when tank capacity is low.

Our community attitudes survey showed strong community support for rainwater tanks, and approximately 32 per cent of South West customers already have one installed.

A review of South West towns highlighted that rainwater tanks yield lower volumes in the northern coastal areas (Bunbury to Dunsborough) than in the wetter areas of the South West such as Pemberton.

Rainwater tanks remain in the portfolio of options for the future. However, on their own, rainwater tanks cannot provide future water supply security.

Any future rebate program or other initiative for rainwater tanks would be assessed on a case-by-case basis.

In response to water shortages, we have run a number of targeted rainwater tank programs in the higher rainfall areas of the South West. A Rainwater Reward Rebate Program was offered to customers from: Balingup, Boyup Brook, Bridgetown, Greenbushes, Hester, Kirup, Manjimup, Mullalyup, Nannup, Northcliffe and Quinninup. Approximately 60 customers took up the offer, resulting in an estimated saving of 3 million litres per year.

Cost analysis of rainwater tanks

As part of W*ater Forever: South West*, we prepared a cost analysis of the potential yield of rainwater tanks in different locations and under varying climate scenarios.

This study found that the costs and yields from a rainwater tank can vary significantly, and that to optimise the yields it is important to maximise:

- roof size to capture the rain
- connections to internal and external use, and
- tank size.

Under a 'best case scenario', rainwater tanks can provide up to 32 per cent of a household's water supply, with costs ranging from $7–$17 per thousand litres.

A summary of the costs and yields of different scenarios is shown in Table 4 below. The scenarios are based on the assumption that there will be a 30 per cent reduction in rainfall by 2060.

Figures 8 and 9 show the volume of water stored in a tank, compared to the volume of water supplied from the rainwater tank and the volume used for Australind and Pemberton. They show that, while there is enough rainwater in the tank to meet non-drinking water uses from May to September, the average daily demand from October to April is greater than the volume supplied from the tank.

The study found that rainwater tanks could provide up to 1.3 billion litres of water to households by 2060 if it was compulsory for all new properties to install rainwater tanks for indoor (toilet flushing and laundry) and outdoor use.

Table 4 Comparative costs for rainwater tanks with outdoor use only and outdoor and indoor use

	Outdoor use only		Outdoor and indoor use	
	2,000 litres	**5,000 litres**	**2,000 litres**	**5,000 litres**
Costs (approximate)				
Tank and pump	$800–$1,600	$1,250–$2,250	$ 1,800	$ 2,250
Plumbing and installation	$650	$650	$950–$1,450	$950–$1,950
Operation and maintenance (per year)	$20	$20	$20	$20
Unit costs (per 1,000 litres)	$8–$28	$7–$23	$7–$18	$7–$17
Residential rainwater tank yields				
Annual yield	6000–21000 litres	9000–29000 litres	16000–37000 litres	19000–45000 litres
Proportion of average annual consumption	2–16 %	7–25 %	3–22 %	7–32 %
Savings to household water bill (per year)	$12–$39	$29–$69	$17–$54	$34–$84

Garden water use is greatest when the supply of water from the tank is at its lowest.

Figure 8 Australind rainwater tank capacity compared with average daily supply and use

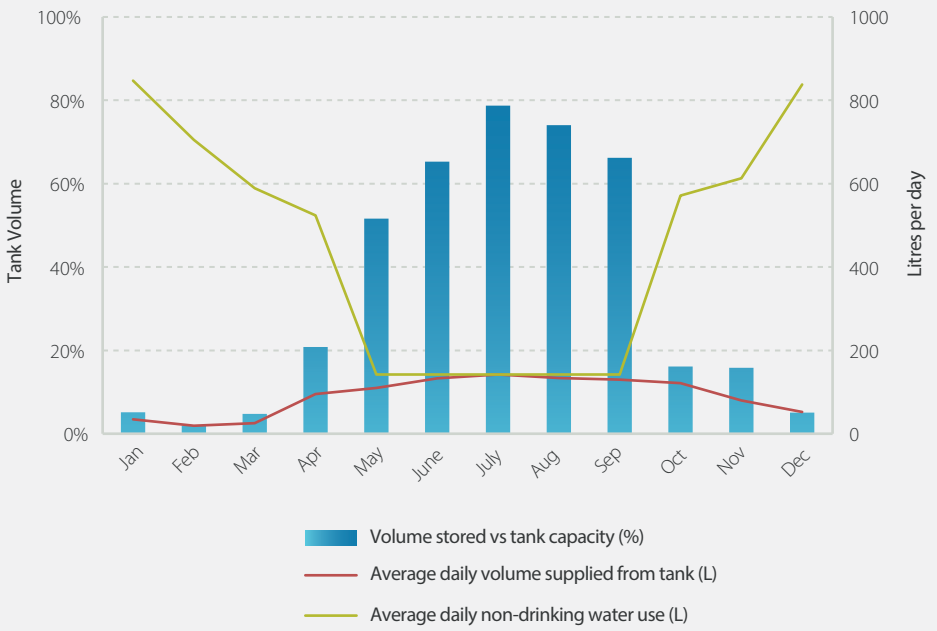
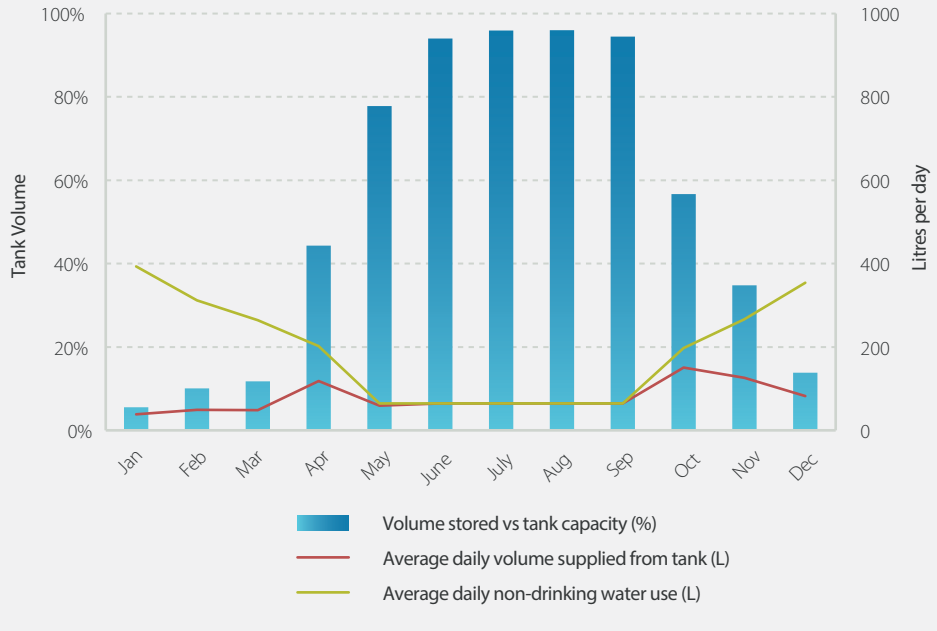


Figure 9 Pemberton rainwater tank capacity compared with average daily supply and use



Water use efficiency in business

Since 2008, our business and industry customers with consumption over 20 million litres per year are legally required to produce Water Efficiency Management Plans. The plans require customers to monitor water use and provide annual reports with evidence of ongoing water use efficiency improvements.

Since the introduction of the Water Efficiency Management Plans, the businesses involved have reduced their water use by approximately 35 per cent.

Given the predominance of small-scale tourism accommodation in the South West, it may be possible to tailor a future water efficiency program to these customers. For example, upgrading showerheads in shared use facilities such as caravan parks can result in a substantial water reduction for a relatively small investment due to the high number of people that use the facilities.

Data logging

We have helped to improve water efficiency with targeted non-residential customers using a combination of data logging and intensive one-on-one customer engagement. We installed data loggers on meters for 23 customers in the South West in 2012–13, which allowed customers to better understand their water use patterns and identify leaks.

We will continue to use data logging to reduce water use in the future.

Leakage and pressure management

Within any water supply system, some water is lost or unaccounted. This is referred to as 'non-revenue water' and includes water that has been used for firefighting purposes, lost through leaks or flushing pipes.

Water losses are frequently due to leakages at pipe joints or breaks in water pipes. Leakage can be difficult to detect because most water infrastructure is below ground, however we can help to reduce this through active leak detection.

In the South West, the amount of water lost has been decreasing due to active leak detection programs and now accounts for between 10 to 15 per cent of the total water supplied.

We will continue to implement leak detection programs in the South West.

Pressure management reduces excessive water pressure while ensuring a minimum level to meet customers' needs and operating standards. Reduced water pressure lowers leakage and reduces the number of leak and burst incidents. We are expanding pressure management in some Perth suburbs, however there are only limited areas within Collie and Bridgetown which are suitable to make it viable.

Smart water meters

Smart water meters provide the technology to gather, monitor and report on water usage data. They have two primary functions: to capture information at regular intervals (for example, hourly); and to transmit this data to another location.

Smart water meters facilitate our ability to provide timely feedback to customers about their water use, detect leakages, and obtain water meter readings remotely.

We have trialled smart water meters in other regional areas across the state and they remain a long-term option for the future.

Water billing

Water bills provide information to customers on how much water they use and can encourage households to reduce consumption. In 2013, we introduced two-monthly billing to make it easier for customers to manage and pay water accounts. It also allows customers to track water use more regularly and adopt water efficiency behaviours as a result, and detect leaks sooner.

The *My Water* online account facility also provides customers with access to bills and water usage more quickly and easily.

In the future, we will continue to use water bills to encourage water use efficiency, for example by including a comparison of water usage between households.

Waterwise programs

We have a range of Waterwise Programs and Specialists to help the community and businesses continue to reduce their water use.

The Waterwise Schools Program aims to educate students, their families and the wider community about the need to value, protect and conserve our water resources. Since the program began in 1995, forty nine schools in the South West have been recognised as waterwise schools, and several have participated in 10 year programs.

There are Waterwise Specialists servicing the region, including garden centres, plumbers, lawnmowing contractors, garden irrigators, landscapers and water auditors.

Waterwise partner

The South West Institute of Technology (SWIT) became one of our waterwise partners in 2010. Since then, we have worked together to embed water efficiency practices into landscape design courses. Through the adoption of a Memorandum of Understanding, we are committed to exploring opportunities to further enhance our working relationship.

Waterwise Council

Together with the Department of Water, and with support from ICLEI Local Governments for Sustainability[6], we have developed a Waterwise Council Program to promote sound water management and improve water use efficiency in local governments and their communities.

The Shire of Capel and the Shire of Augusta-Margaret River are recognised waterwise councils, and have saved a combined total of nearly 189 million litres per year by implementing community education programs, council facility retrofits and water reuse initiatives.

Waterwise schools

Glen Huon Primary in Eaton has been a recognised Waterwise school since 2007 and has actively taken part in a number of water efficiency projects in partnership with us.

We identified a number of schools across the state whose consumption was considered above average, relative to the size of the school and areas of playing fields. Glen Huon staff members, students and the school community responded to the need to reduce the school's water use by implementing a number of initiatives. They undertook intensive metering to understand water consumption patterns, and put in waterwise garden areas.

The school's overall consumption was cut by more than 60 per cent. The cost of the project was covered within one year as the reduction in water consumption resulted in water savings of over $25,000 for the school.

5. ICLEI is an international association of cities and local governments dedicated to sustainable development, iclei.org

Opportunities to further reduce water use

Household bores

Garden bores can provide a cost effective source for irrigating gardens, thereby reducing the demand for scheme water.

Along the Swan Coastal Plain, from Australind to Busselton, the presence of relatively good quality shallow groundwater allows about 3,500 households to use garden bores.

The Department of Water estimates garden bores in the South West region use up to 12,000 million litres per year[7]. As garden bores are not required to be metered, the total volume of water abstracted is not known.

Residents do not need to apply to the Department of Water for a groundwater licence if the garden bore accesses the superficial aquifer (not a confined aquifer) and it is for domestic use.

It is estimated that additional domestic bores in new urban areas could save up to 1 billion litres of scheme water. A domestic groundwater feasibility map, as exists for Perth, would need to be developed by Department of Water to facilitate the sustainable expansion of groundwater bores.

Currently a three-day-a-week watering regime for domestic bores in the Perth metropolitan area, and a similar measure may be needed in the South West.

We support increased monitoring and reporting of household bores, and the use of garden bores as an alternative water source for watering gardens where the hydrogeology allows for a sustainable draw.

Building codes

The Building Commission of WA and local governments set building and housing code requirements.

Incorporating improved water efficiency requirements into building codes can be an effective way to achieve water efficiency in new homes. For example, current building standards in Western Australia require that all household fittings have a Water Efficiency Labelling and Standards (WELS) scheme rating of three stars or above.

Our community engagement activities showed that there is broad community support for water efficiency measures being included in the building code, such as compulsory rain water tanks for new houses.

However, while there is community support, our analysis shows that these are not a cost effective water source (see page 22).

Town planning

We work with the Department of Water and the Department of Planning to achieve more efficient water use in town planning. However, apart from the building code standard, there is no legislative requirement to meet performance targets for water use in new developments.

The Western Australian Planning Commission has issued the *Better Urban Water Management Guidelines (2008)* to assist with new projects, and we have waterwise developer guidelines for water efficient landscaping and H_2Options for non-drinking water guidelines.

Some shires have included water sensitive criteria in their local planning policies (see Shire of Capel case study next page).

A key focus for us will be to continue to engage with local shires and developers to facilitate urban development that has smarter use of water. The Department of Water will play a key role in this area, together with the Department of Planning.

Public open space

Most parks and ovals are the responsibility of local shires and are typically watered using self-supply systems. In the South West, many local shires have their own dams to collect stormwater or their own groundwater bores. Where an alternative water source is not available, or insufficient volumes are available, scheme water is used.

In the areas of Greater Bunbury and Greater Busselton, public open space is preferentially irrigated by groundwater because groundwater is free. Ongoing urban growth in these areas will lead to an increase in the demand for water for public open space, however groundwater availability is becoming limited.

The Department of Water estimates that the demand to irrigate public open spaces in the Busselton-Bunbury area may increase from 3.4 to 6.6 billion litres by 2060, and that there is not enough free groundwater available to meet future requirements.

7. Department of Water, South West Regional Water Plan 2010

The waterwise display village in Dalyellup.

Shire of Capel case study

In 2011, the Shire of Capel changed the *Dalyellup Beach Estate Local Structure Plan* to include a new display village that showcases sustainability features and water saving principles in landscaping design and building developments.

The shire has incorporated our waterwise guidelines and criteria to ensure that display home owners and project builders include these principles into building submissions.

The Shire of Capel won the Waterwise Council of the Year award in 2012 and one of the houses in the display village won the 2014 Waterwise Home of the Year at the South West Master Builders Association Awards.

Irrigation of public open space can be minimised by:

- irrigating active playing areas only
- hydro zoning the areas around playing fields into waterwise garden beds instead of grass
- replacing verges and passive green space with waterwise gardens, and
- using alternative water sources such as stormwater harvesting or recycling wastewater.

Agriculture

Approximately 50 per cent of water in the South West is used on agriculture[8]. This includes surface water and groundwater. Almost all of this water is self-supplied rather than from a public water supply, which means Water Corporation has a limited role in agricultural water use.

The Department of Water manages 2,500 groundwater licences in the South West and estimates approximately 79 billion litres (or 40 per cent) is allocated for agriculture. The actual volume of water taken may be less because not all bores are metered, and the department estimates most licensees use only 85 per cent of their allocation.

The department's current approach in the South West region is for bores of more than 50 million litres per year to be metered. This provides information to best manage the groundwater system.

8. Department of Water, South West Regional Water Plan 2010

Water pricing in the South West

Our customers are charged for water and waste water services. The State Government sets water prices based on advice from the Economic Regulation Authority, and provides concessions for some customers (such as pensioners and seniors).

Water charges comprise:

- a fixed service fee (which is the same for all customers) and
- a water use charge (based on actual consumption), which is incrementally applied over four tiers as usage increases.

Water use charges vary between towns based on the actual cost of providing water in that town, with towns grouped into five classes.

The State Government also provides a pricing concession through a 'uniform pricing policy'. Under this policy, our residential customers in the South West are charged at the same water use charge as Perth for the first two tiers that are 0–150,000 litres and 150,000–300,000 litres. For volumes of water greater than 300,000 litres, water charges increase based on the actual costs of supply.

Increasing water prices to drive efficiency was raised at some of our community engagement activities, and in comments received on the draft plan. However, in the community attitudes survey, only two in 10 customers were prepared to pay more for their water. This is consistent with customer information, which shows that the South West has the highest number of regional customers on payment plans.

Instead of increasing water prices, changing the tariff structure of water bills may help with water efficiency. By adopting a daily water use tariff, as opposed to the current four-tiered system which is applied over the year, customers would know sooner when large volumes of water are being used.

In the future as we move away from cheaper groundwater to more expensive alternative water sources, the community would like to be informed of future cost rises and the cost of water supply.

Increase water recycling

Across Western Australia, we have set a target to recycle 30 per cent of wastewater by 2030.

The current and projected wastewater flows for the South West are shown in Table 5.

The major wastewater treatment plants (Bunbury, Busselton and Kemerton) produce about 70 per cent of the wastewater flows, with the other 13 plants producing only small amounts.

The amount of wastewater collected and treated into the future will depend on town growth rates, infill sewerage developments and levels of water use.

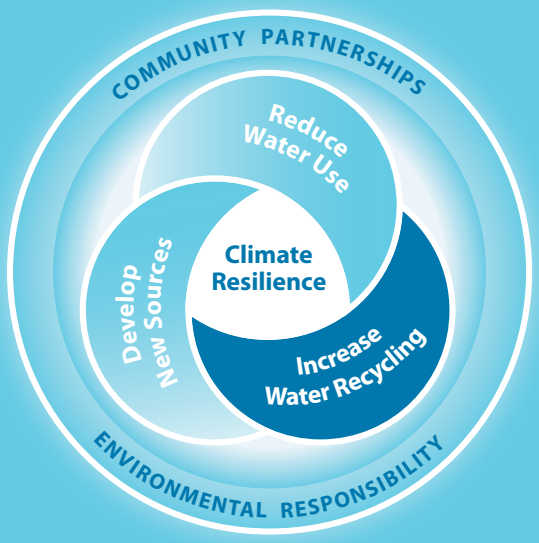


Table 5 Current and projected wastewater flows for Water Corporation wastewater treatment plants in the South West

Wastewater system locations	Actual flows at 2012 (million litres per year)	Estimated flows at 2030 (million litres per year)	Estimated flows at 2060 (million litres per year)
Bunbury	2,900	5,900	9,800
Busselton	1,500	3,000	5,500
Kemerton	1,300	1,300	1,900
Collie	600	800	900
Dunsborough	500	700	1,200
Margaret River	400	900	1,500
Manjimup	300	450	800
Donnybrook	100	200	300
Brunswick Junction	100	100	100
Bridgetown	70	200	300
Capel	70	200	300
Augusta	50	100	200
Pemberton	50	100	100
Dardanup	30	100	200
Burekup	30	50	100
Nannup	30	50	70
TOTAL	**8,000**	**14,500**	**23,500**

Note: Flows have been rounded so totals may not tally. Many small towns in the South West use septic tanks for wastewater disposal.

What has been achieved?

In order to support recycling, we provide free recycled water 'at the gate' of wastewater treatment plants for schemes that benefit the community. It is the responsibility of the user to build storage, conveyance and irrigation infrastructure.

Recycling opportunities are most favourable when:

- there is a supply gap and some uses of scheme water could be substituted with recycled water
- the cost or difficulty in developing a new drinking water source is high
- recycled water is the best 'fit for purpose' water available for an existing or intended use, and/or
- recycled water does not need storage and can be used almost immediately.

Currently wastewater is recycled at 11 locations in the South West and used on public open space, woodlots and orchards (see Table 6). Most recycled wastewater is used over summer, with winter flows either returned to the environment or kept in storage dams.

Water recycling on public open space generally is done in partnership with local shires.

Treated wastewater that is recycled onto woodlots may be made available to other users, who must meet any additional costs.

It is recognised that the Water Corporation does not provide wastewater services in many south west towns. Community feedback highlighted that larger volumes of wastewater could be produced for recycling on public open space if infill sewerage was constructed in these towns.

Table 6 Current water recycling schemes in the South West

Wastewater systems	Water recycling schemes
Busselton	Busselton golf course
Kemerton	Woodlot
Dunsborough	Woodlot
Margaret River	Public open space, golf course, woodlot
Manjimup	Golf course, woodlot
Donnybrook	Orchard, woodlot
Bridgetown	Golf course
Capel	Wetlands
Pemberton	Public open space
Dardanup	Woodlot
Nannup	Woodlot

The Shire of Augusta-Margaret River previously took water from the Margaret River to irrigate public open space.

In 2010, the shire developed a project to take up to 180 million litres of treated wastewater from the Margaret River Wastewater Treatment Plant and use it to irrigate ovals at Gloucester Park, Margaret River High School, Margaret River Primary School, and public open space in East Margaret River and the Margaret River Golf Course.

Opportunities to increase water recycling

Public open space

Most parks and ovals are the responsibility of local shires, and are watered using self-supply systems, such as their own dams and/or groundwater bores.

An alternative is to use recycled water for irrigating public open space. This is most cost effective when the wastewater treatment plant is located near the sites being watered, or where large volumes are required.

However, there are still significant costs especially when large storage may be needed. In 2011, the City of Busselton investigated reusing wastewater from the Busselton and Dunsborough wastewater treatment plants on public open space. It assessed that the cost of the scheme would be unfeasible without other sources of funding. For more information on this proposal, contact the City of Busselton.

As the climate dries and water resources become fully allocated, water recycling will become more necessary.

Water recycling to agriculture

There may be future opportunities to supply recycled wastewater to irrigate crops, including fruit and vegetables. These opportunities tend to require large volumes of recycled wastewater and only become viable when there is insufficient surface or groundwater to meet the needs of growers.

Recycled water can be an expensive water source for crops. The developments of recycled water schemes in other states have been made possible through establishing agricultural precincts near wastewater treatment plants, generally with a government subsidy.

As groundwater areas on the Swan Coastal Plain become fully allocated, water recycling to agriculture may become necessary to support expansion.

For example, treated wastewater is available at the Kemerton Wastewater Treatment Plant, which could be used by nearby growers in Myalup. As this recycled water costs more than groundwater, this option has not been progressed to date. However, if groundwater in Myalup becomes more saline or unavailable, recycled water may become more commercially attractive in the future.

One option to be further investigated is the use of managed aquifer recharge to facilitate recycling. Managed aquifer recharge is when water is pumped into an aquifer, under controlled conditions, for storage. As more wastewater is produced over winter, with irrigation demand mostly over summer, managed aquifer recharge is a way of solving this timing issue and minimising costly storage requirements.

Busselton wastewater – Managed aquifer recharge for agriculture

Currently water from the Busselton Wastewater Treatment Plant is reused on the Busselton Golf Course, with the remainder directed to the Vasse agricultural drain. A future option could involve taking highly treated wastewater from this plant, further treating it and recharging it into the aquifer. The water would then be available to agricultural users.

The total volume of wastewater available for reuse will depend on population growth in the Busselton area, however about 3.2 billion litres per year of recycled water potentially could be produced by 2060.

We are investigating the feasibility of managed aquifer recharge in the Busselton area for agricultural use. Where the groundwater is close to the surface, it may not be possible. However, if this option is technically feasible in some areas, it would require additional pipelines and recharge bores, further field work and trials, and approvals from the regulators, which could take six to eight years.

If the recycled water is only available for agricultural use, this option does not help to reduce the gap between drinking water demand and supply.

Water recycling to industry

The viability of recycling wastewater that could be used by industry depends on the type of industry, its water demands and the alternative water sources available. In Perth, we have been successfully providing recycled water from the Kwinana Water Recycling Plant to industry since 2004.

In the South West region, the Kemerton Wastewater Treatment Plant was constructed within the Kemerton Industrial Estate with a long-term view of providing recycled water to industry when required. As the commercial costs of a reuse scheme is currently greater than the cost of groundwater sources, it has not been reciprocated. Currently we have been using the recycled water on woodlots.

The options for reuse in the future will be driven by industrial developments in the South West.

Water recycling for the environment

The return of wastewater to the environment can help supplement ecosystems in a drying climate. If pathogen and nutrient levels are adequately addressed, recycled wastewater can provide an alternative water source. For example, in Capel, recycled water from the wastewater treatment plant is used to supplement the nearby wetlands.

Water Corporation is not the responsible agency for ecosystems management. However, under a drying climate, recycled water could form a valuable water source to help support natural systems. Additional research and regulatory approvals would be required to progress a scheme.

In general this option does not help to significantly reduce the gap between drinking water demand and supply.

Water recycling for drinking water

There are two main ways of recycling water for drinking water - indirect potable reuse or direct potable reuse.

Groundwater replenishment

Indirect potable reuse involves an environmental buffer before the recycled water goes into a water supply system, such as groundwater replenishment.

Groundwater replenishment is the process where treated wastewater is further treated to drinking water standards and recharged into a groundwater system. The water is then stored in the aquifer and taken out some time later for further treatment and supply to a drinking water system.

It has been successfully done in Orange County in the United States since the 1970s and, following the completion of a three-year Groundwater Replenishment Trial and community support, a full-scale scheme in Perth's northern suburbs is expected to be recharging recycled water from about late 2016.

As a sustainable water source that does not rely on the climate, groundwater replenishment has the potential to recycle large volumes of water, naturally. It means we can boost groundwater reserves and maintain groundwater levels during periods of low rainfall.

Groundwater replenishment is more cost effective in areas with large wastewater flows and with access to suitable brine disposal, for example ocean outfall. It is only technically feasible if there is a suitable aquifer to store the recycled water. The ideal areas in the South West for groundwater replenishment are near Bunbury, Busselton/Dunsborough and Margaret River.

We estimate that it would take at least six to eight years to obtain the necessary regulatory approvals for a groundwater replenishment scheme in the South West.

Groundwater replenishment options are also included under 'Develop new water sources,' pages 36-67.

Direct potable reuse

Direct potable reuse involves treating wastewater to drinking water standards, and connecting it to pipelines or storage tanks where it mixes with water from other sources. This water recycling currently operates in Windhoek, Namibia, and Texas, USA.

While it is considered technically feasible and safe to supply highly treated wastewater to drinking water schemes[9], to minimise risk, the *Australian Drinking Water Guidelines* recommend an environmental buffer, such as a dam or aquifer.

Many drinking water recycling schemes that use an environmental buffer including Perth's Groundwater Replenishment Trial plant have shown that it is possible to operate the advanced water treatment plants and consistently produce safe drinking water.

Where there is no suitable environmental buffer, the requirements for regulatory approvals and public acceptance do not make this a viable water source in the short or medium term.

Recycled water into dams

In the areas of Bridgetown, Manjimup, Nannup and Pemberton, there are no suitable aquifers for storage. An option is for treated wastewater to be treated to drinking water standard and transferred to a local dam. At a later date, it would be taken out, treated again to meet drinking water standards and supplied to customers.

Recycling water into dams would require more investigation before it could be included as a potential option.

Additionally, current advanced water treatment technology uses membranes that necessitate disposal of a brine stream. Brine disposal is typically through pipelines to the ocean or evaporation ponds. In these inland areas, the distance to the ocean and the low evaporation rates make brine disposal problematic. Over the next fifty years, a 'zero discharge' technology may be developed which may help to overcome the challenge of brine disposal.

These are not currently options for the South West in the short or medium term.

9. Australian Academy of Technological Sciences and Engineering, Drinking water through recycling — the benefits and costs of supplying direct to the distribution system.

A school group tours the Groundwater Replenishment Trial site in Perth.

Managing salt water intrusion

In coastal areas, there is the potential for salt water to move into freshwater aquifers — this is called salt water intrusion, and it can lead to contamination of water sources. Salt water intrusion occurs naturally in coastal areas because of the connection between groundwater and seawater. Where there is reduced groundwater outflow in the aquifer, due to lack of rainfall or groundwater abstraction, the potential for salt water intrusion can increase.

The hydrogeology of the Swan Coastal Plain and Scott Coastal Plain means these areas are susceptible to salt water intrusion. This problem may exacerbate over the next 10–20 years and some areas in Bunbury have already seen an increase in salinity.

We actively monitor our bores for salinity changes as do other licensees. The Department of Water is responsible for managing the salt water interface across the region.

Managed aquifer recharge for salt water intrusion in Bunbury/Dalyellup

In some areas of the world, such as California, highly treated wastewater can be recharged into the aquifer to build up a pressure head, and form a fresh water barrier against salt water intrusion. In the South West, this opportunity is limited to Bunbury, as it is the only location where there is sufficient recycled wastewater available to form a barrier.

This option would involve recharging highly treated wastewater from the Bunbury Wastewater Treatment Plant into the Yarragadee Aquifer through several recharge bores close to the coast, west of Dalyellup.

The wastewater available from the Bunbury Wastewater Treatment Plant is estimated to be 9 billion litres per year, and there is a potential to recharge 6 billion litres per year into the Yarragadee Aquifer. Further investigations would be required to determine if this will form a sufficient barrier to reduce salt water intrusion risks to the Dalyellup bores.

Alternatively, stormwater could be used to form a salt water barrier. This option helps reduce the risk of salt water intrusion, but does not necessarily increase the amount of drinking water available.

Greywater recycling at home

Greywater is the water from the kitchen, laundry, bath and shower which can be re-used for non-drinking water purposes.

The most common way to recycle water at home is to directly bucket or transfer greywater onto lawns and gardens. Our survey of South West customers in 2014 indicated that about 38 per cent of them recycle laundry greywater to water gardens.

Alternatively, an onsite greywater treatment system can be installed. These can cost between $4,000 and $20,000 depending on the product, level of treatment and installation costs. Additional information on the cost per kilolitre of water can be found in the fact sheet at watercorporation.com.au/waterforeversw.

As most houses in WA are built on concrete slabs, it is difficult and expensive to retrofit a greywater system. Sustainable housing principles are moving toward 'greywater ready' systems where the plumbing is installed when the house is built so that a diversion system can be installed later.

Greywater systems contain high levels of nutrients and salts (for example, from laundry soaps) which may make them unsuitable for watering native vegetation and vegetable crops.

The Department of Health's *Greywater Code of Conduct* provides a framework for how and when greywater should be used.

We support the use of household greywater solutions that are safe, effective and do not cause harm to the environment.

Purple pipe schemes

Purple pipe schemes are where two separate pipes deliver two types of water — one for drinking water and the other for non-drinking uses, such as watering gardens or toilet flushing. They are also known as dual reticulation or third pipe systems.

The water source for non-drinking uses can be recycled water, greywater, stormwater, rainwater or groundwater.

Purple pipe schemes are progressed by developers and may be feasible for new developments in regional areas where scheme water is scarce and further expansion of the scheme is more costly. They may also be viable for irrigating public open space (as an alternative to scheme water) and for large-scale industrial developments.

We work with proponents to develop concepts for purple pipe schemes and will consider involvement with schemes at the invitation of a land developer or customer.

We have operated a purple pipe scheme at Denham for many years, and helped with the planning and development of the purple pipe scheme at 'Green' Estate in Brighton, north of Perth.

Private water service providers also can develop and operate non-drinking water schemes in Western Australia.

Stormwater harvesting

Stormwater is runoff from roads, driveways and other surfaces following a rain or storm event, and can be an alternative water supply for non-drinking water uses.

In built-up areas, stormwater can be:

- locally infiltrated (put back into groundwater) through sumps, soak wells and porous driveways
- collected from roofs and sealed surfaces in a tank and reused via rainwater tanks,
- collected by drains (primarily for flood protection) and then released back into the environment or reused.

Details on rainwater tanks and domestic bores are included under 'Reduce water use', pages 21–22 and 26.

The seasonal nature of rainfall in the South West means we would need to use large water storage facilities during winter and, unless groundwater aquifers can be used, this greatly affects the cost and viability of stormwater harvesting schemes.

The quality of stormwater is variable and can include sediment, fertilisers and hydrocarbons, which makes it better suited as a non-drinking water source.

In the past, the primary function of stormwater management was to ensure adequate drainage networks to avoid flooding of roads and infrastructure. However there is a growing interest in harvesting stormwater and improving the water quality to protect waterways.

It may be possible to use stormwater to create a salt water barrier on the coast.

Water Corporation does not own, manage or operate drainage networks for cities and towns in the South West, but it does manage some rural drainage.

Local shires are responsible for assessing water management plans, including drainage, and providing clearance for subdivisions.

The Department of Water is responsible for assessing flood and inundation risks from land development through drainage and water management plans. They also assess and endorse district and local water management strategies.

The Department of Water has developed the 'Water Sensitive Urban Design' (WSUD) guidance notes to help developers incorporate water sensitive principles into proposed land developments, including the drainage design.

Figure 10 Rural drainage districts in the Water Forever: South West study area

Rural drainage management

In the 1900s, a growing demand for suitable agricultural land led to the construction of rural drains on the Swan Coastal Plain. The then Water Authority, and subsequently the Water Corporation, has been responsible for managing rural drainage for flood management since 1985. These drains are allowed to flood or inundate surrounding land for up to three days (72 hours).

As land surrounding rural drains is urbanised, the management of the drain is negotiated with the local shire and the limitations of the rural drain are incorporated into the development designs. Over the next 50 years, ongoing development along the coast is expected to result in changes to the management of rural drains.

There are two main rural drainage districts within the *Water Forever: South West* study area: Roelands and Busselton (see map above). These two networks have catchment areas of about 212,000 hectares and 201,700 hectares, and include drainage systems which are designed to service rural properties only.

There is limited information available on actual flows within the rural drainage districts, but we estimate that approximately 90 per cent of the Roelands district and 50 per cent of the Busselton district provide flows to the Leschenault Inlet and the Vasse-Wonnerup Inlets respectively.

Some agricultural landholders already harvest and use water from the rural drainage network, and we expect this will increase as the climate continues to dry.

Proposals to harvest additional water from the rural drainage network would require assessment of existing agricultural water uses and environmental water provisions.

Harvesting of rural drainage water has not been included as a future drinking water source option.

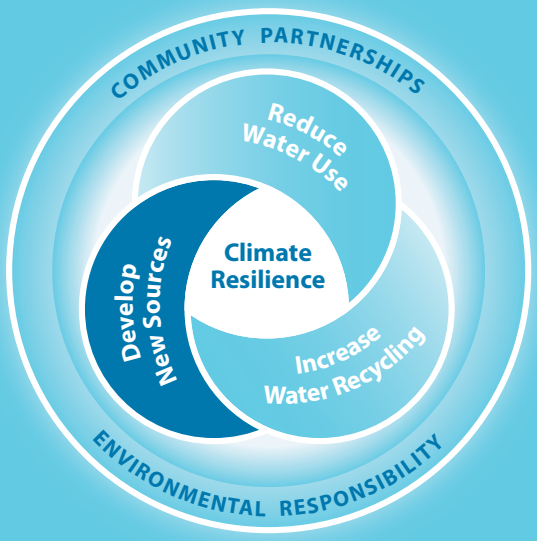
Detailed environmental and hydrogeological investigations would be required before this is included as a future option.

Develop new water sources

This section provides an overview of the potential new water source options to help meet future drinking water supply needs.

In addition to assessing the technical feasibility of the options, we undertook comprehensive sustainability assessments (see page 15). However, further investigations, detailed planning, cost analyses and approvals processes would be required before developing any option.

Table 7 gives an overview of the sources included in the portfolio of options at this time. These will not necessarily be developed now or at any time in the future — their inclusion indicates that they will be considered when water supply for an area needs to be increased.



Overview of source options

Table 7 Overview of new source options for South West region

Water source options included in portfolio		
Desalination: West coast desalination South coast desalination Windy Harbour desalination Southern Seawater Desalination Plant expansion	**Surface water** Nannup Brook Camp Creek Gregory Brook Northcliffe Dam **Groundwater:** Groundwater from the public water reserves	**Source optimisation:** Catchment management Groundwater trading Evaporation from dams Bulk water purchase **Water recycling:** Groundwater replenishment Surface water replenishment
Water source options not included in portfolio		
Surface water: Wellington Dam Brunswick River Ellis Creek	**Groundwater:** Inland saline reserves Collie Mine Groundwater	**Source optimisation:** Cloud seeding

The potential source options are grouped into five areas: Swan Coastal Plain, Collie, Margaret River–Augusta, Warren–Blackwood, and Pemberton, Northcliffe and Quinninup.

Our analysis of climate risks highlighted that while average yields are sufficient for now, water supply systems such as Collie and the Warren-Blackwood, which are supplied primarily from dams, are susceptible to a series of dry winters.

By developing a portfolio of options through this planning study, we will be able to respond to changes in water availability if required.

Surface water sources (dams)

We operate 15 dams across the *Water Forever: South West* study area, which have provided low-cost, plentiful water over many years. These dams are particularly important to town water supplies east of the Darling Scarp where there is limited groundwater.

Surface water sources can present higher risks with water quality than groundwater, which has the aquifer as a filter. To ensure safe drinking water, the Department of Water and Water Corporation limit activities within a catchment and in the reservoir. Ideally, the catchments are state forest or national park with limited or no public access or amenities.

An increased understanding of water quality risks and improved *Australian Drinking Water Guidelines* has led to some surface water sources, such as Northcliffe, Quinninup and Balingup no longer being acceptable as a drinking water supply. In the long run, other small dams may be used solely for storage within a larger integrated water supply system. At some larger dams, we use other water quality measures, such as higher levels of treatment, to manage water quality risks.

The declining and increasingly inconsistent rainfall in the South West region has made dams less reliable and climate projections indicate this will continue.

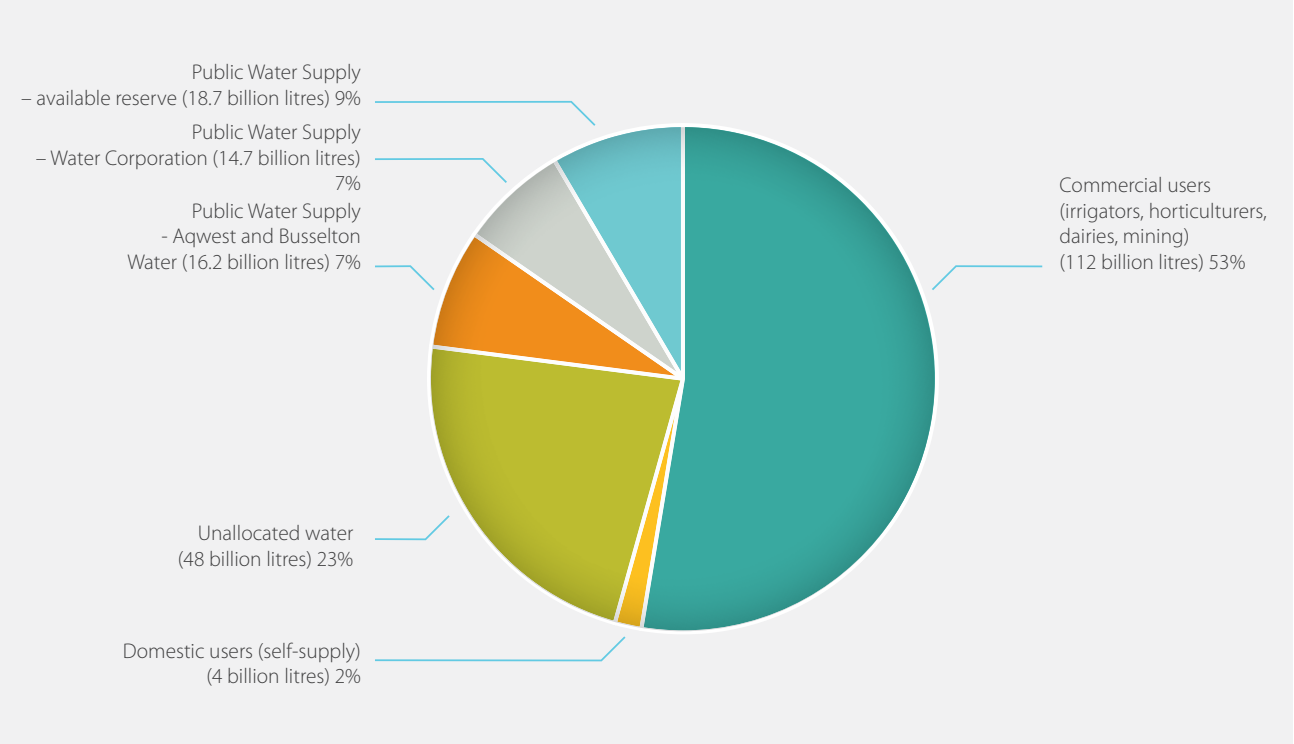
Dams will continue to play a key role in our water supply schemes by capturing run-off during wet years, buffering peaks in demand and working in conjunction with other sources.

As a result of community input we have included four additional surface water sources in the portfolio of options — Gregory Brook, Nannup Brook, Camp Creek and Northcliffe Dam. Some community stakeholders have expressed concern in response to the draft plan over new dams and the associated limitations on recreational activities in the catchments.

Table 8 Capacity of existing Water Corporation dams in the South West

Nearest town	Dam	Capacity (million litres)
Balingup	Balingup Dam	61
Boyup Brook	Boyup Brook Dam	129
Bridgetown	Millstream Dam	1,000
Collie	Harris Dam	71,000
	Mungalup Dam	681
Greenbushes	Greenbushes Dam 1	95
	Greenbushes Dam 2	96
Hester	Hester Dam	118
Kirup	Kirup Dam	60
Manjimup	Manjimup Dam	1,600
	Phillips Creek Dam	269
Margaret River	Ten Mile Brook Dam	1691
Nannup	Tanjanerup Dam	156
Pemberton	Big Brook Dam and Lefroy Weir	627
Quinninup	Quinninup Dam (contingency supply only)	713

Figure 11 South West groundwater areas allocations (213 billion litres total)



Groundwater sources

Groundwater is a major water source for many users in the South West region.

The Department of Water sets limits on the amount of groundwater that can be abstracted in the South West through the *South West Groundwater Areas Allocation Plan (2009)*. This plan takes into account the ecological, social and economic values of water resources and aims to achieve a balance between users, and the protection of the environment.

This allocation plan has incorporated a predicted rainfall reduction, due to the drying climate, when calculating the sustainable groundwater abstraction volumes. The CSIRO study of sustainable yields indicates that a declining rainfall is likely to result in additional reductions in groundwater levels in the South West, particularly for areas on the Blackwood plateau.

The allocation plan identifies approximately 213 billion litres of groundwater available for use each year, and Water Corporation's allocation is 14.7 billion litres.

To cater for growth in the South West, the Department of Water has set aside a groundwater allocation for the region's future drinking water supplies. This is referred to as the 'public water supply reserve'.

There is approximately 18.7 billion litres per year of groundwater in the public water reserves, which is about 9 per cent of the water available in the plan. To access this reserved water, a public water utility must submit to Department of Water a Source Development Plan prior to the licence assessment process. The Source Development Plan must include evidence of the utility's water efficiency targets.

The Department of Water has developed a policy to allow other users to access the public water reserve on a temporary basis. For more information, see *Department of Water Operational Policy 5.01 'Managing water reserved for use by drinking water service providers'* at water.wa.gov.au.

The *South West Groundwater Area Allocation Plan* reserves groundwater to meet town water demand to 2034.

As a result of strong water efficiency gains by customers of Water Corporation, Aqwest and Busselton Water, the existing public groundwater reserve is estimated to be able to meet regional demands beyond this timeframe if groundwater is available and allocations are not reduced due to a drying climate.

Southern Seawater Desalination Plant near Binningup

Seawater desalination

Seawater desalination is a secure water source that does not rely on rainfall. The Perth Seawater Desalination Plant in Kwinana and the Southern Seawater Desalination Plant near Binningup supply almost half of Perth's water needs (up to 145 billion litres per year).

With an unlimited supply of seawater, a desalination plant could provide drinking water to help meet demand well into the future. The capacity of plants would be planned in stages to meet demand as required. Each stage could, for example, provide about 5 billion litres of water per year. These small-scale plants, or micro desalination plants, would be significantly smaller than the Southern Seawater Desalination Plant, which has the capacity to produce 100 billion litres per year.

A micro desalination plant, along with the necessary infrastructure, would have a relatively small physical footprint, with possibly less than two hectares of land needed.

There are different types of desalination technology, for example reverse osmosis, which involves pushing water through a membrane at high pressure, and distillation, which involves evaporating the water and collecting the condensate. The most common desalination technology in Western Australia is reverse osmosis.

We have already undertaken some high level investigations along the South West coast to identify possible locations and will investigate these further if desalination is selected as a preferred option.

The criteria for a potential site include:

- close to the ocean
- easy integration into existing town water supply systems
- easy access to a suitable power source
- environmentally compatible, with minimal impact on environmentally sensitive areas
- suitable size
- adequate buffers for chlorination facilities
- compatible surrounding land uses (industrial, rural, park or recreational).

There could be environmental advantages if renewable energy was used, for example, wave power desalination is now being trialled in WA.

We would manage any potential impacts on the marine environment by ensuring the brine disposal is dispersed rapidly to background ocean levels.

Reducing evaporation from dams

There are eight dams in the South West region which are main surface water sources.

We estimate the average losses due to evaporation from these dams amount to approximately 6 billion litres per year. Reducing these losses would make more water available from these sources.

Some ways to reduce evaporation losses include floating covers or objects, chemical retardants, deepening reservoirs and windbreaks.

The use of floating covers was considered as part of this planning study. We found that this method has only been applied to smaller areas, generally between 0.2–0.3 hectares, with an exception of one case where it was applied to an area of 2.3 hectares.

The surface area for the eight dams ranges from 5 to 960 hectares so the effectiveness of using floating covers for these dams, along with the associated environmental issues and occupational safety challenges, is currently unknown. Reducing evaporation is also a climate dependent option.

Several institutions, such as the Cooperative Research Centre for Irrigation Futures, are doing further research into reducing evaporation from dams. While this is not a short-term option, the research findings will provide a better understanding of what can be done in the South West region and therefore reducing evaporation in dams remains a long-term option.

Catchment management

Many dams in the South West have forested catchments. Due to logging, mining and farming, the forest landscape has been altered and the regrowth forests are generally much denser compared to what they were in their natural state. Together with the drying climate, this has resulted in reduced rainfall run-off into dams because there are more trees and vegetation competing for the same amount of (or less) water.

One of the catchment management techniques the Water Corporation has used to improve dam inflows is catchment thinning, which involves the selective removal of trees and undergrowth in regrowth forests.

From 2005 to 2013, we conducted a trial in the Wungong catchment which showed that catchment management can be effective in higher rainfall areas where groundwater levels have not already substantially decreased.

The treatments used during the trial included selectively removing crowded trees, controlling re-growth and, in some areas, gradually replacing introduced species of trees with native species. These activities can help to return the forest to a more natural state, making more water available to the environment, which in turn increases groundwater levels and flows into streams and dams.

Catchment management is possible for the following catchment areas of the South West, where there is higher rainfall or where rainfall has not reduced substantially:

- Stirling Dam
- Harris Dam
- Phillips Creek Dam
- Manjimup Dam
- Ten Mile Brook Dam, and
- Big Brook Dam

About 50–60 per cent of the catchment areas could undergo catchment management. Reserved areas such as fauna habitat zones and stream reserves would not be managed.

Catchment management could potentially generate 1–2 billion litres of inflow depending on rainfall levels. Although it relies on the climate, catchment management is a long-term option.

Any catchment management proposal would be subject to requirements set out in the *Forest Management Plan 2014–2023*. This plan was prepared by the Conservation Commission and Department of Parks and Wildlife, and approved by the Environmental Protection Authority.

Water trades, transfers and agreements

Water trades, transfers or agreements facilitate the movement of water entitlements from those who already have a licence to take water to those who want water. Water trading is where:

> *"A water entitlement (i.e. a quantity of water that the licensee is entitled to take under their licence) is either permanently or temporarily (for a specified time period) traded to another person and the water will be taken from another location."*

The reasons for trading can vary. For example, the licensee may not be using all the water allocation on their licence so will trade the unused portion, or the licensee makes water efficiency gains, which frees up water for trading.

The Department of Water must assess and approve the trade of licences. It manages a 'water register', which is a web-based program designed to help the general public access information about licensing and water availability.

Harvey Dam

In the past, we have undertaken short-term agreements to purchase water seasonally, as well as permanent water trades with farmers and irrigators. Short-term agreements are best suited in times of drought and to help meet a short-term water need.

A permanent trade, which was done with Harvey Water in 2006, helps to secure a long-term water supply.

In 2010, we signed a long-term water transfer agreement with Busselton Water to supplement the Dunsborough-Yallingup water supply, and are investigating the option of a bulk water agreement with Aqwest for supply to Dalyellup.

There are over two thousand five hundred groundwater licences in the South West however only 2 per cent are for volumes of more than 500 million litres per year. With licences of smaller amounts, multiple trading parties would be required, making it a more involved process.

Our initial investigations highlighted the Scott Coastal Plain as a potential location for water trading because there are licences to abstract large amounts of water within this area. Therefore, it remains a long-term option.

Water carting

We cart drinking water to small towns in Western Australia when the local water sources cannot meet the needs of the town due to:

- potential water quality issues when people live in close proximity to a water source
- poor water quality when dams reach low levels (for example, Mullalyup and Kirup), or
- low rainfall and reduced inflows into dams, or slow recharging of groundwater (for example, Northcliffe).

At times, we also cart water as a safeguard to ensure there is a continual supply to an area.

For towns remote from a safe and secure water source, water carting can be the most economical option for public water supply compared to installing pipelines and water treatment plants. This is currently the case for Northcliffe and Quinninup both of which receive water from Pemberton.

Water carting also ensures that the water supply meets drinking water standards.

While there can be issues with traffic management, noise levels from carting trucks, as well as the environmental impact of water transfers and energy use, at the current growth rates, water carting in Quinninup and Northcliffe remains a medium term solution.

Water carting also remains a medium term solution for Kirup and Mullalyup due to water quality issues, and until the connection from Mullalyup to Greenbushes is complete.

Other options

Cloud seeding has been previously investigated for the South West however in its current status it is not financially or economically viable due to various reasons.

Cloud seeding need winds to be below a certain speed and these conditions are most common in mountainous areas. This is challenging for most of Perth and the South West of Perth. In addition, cloud seeding still has many uncertainties with its impact on ecosystems, farmlands and nearby landholders. Water Corporation will continue to monitor this technology as it evolves.

Planting trees has been proposed as a way to increase rainfall in the South West. This option has not been included in this plan as Water Corporation does not control enough land and this option may not be effective at increasing rainfall.

Towns on the Swan Coastal Plain

The Swan Coastal Plain includes areas from Australind to Dunsborough where Water Corporation provides water services to the towns of Eaton, Australind, Roelands, Brunswick Junction, Capel, Peppermint Grove Beach, Dardanup, Donnybrook, Dalyellup, Dunsborough and Yallingup.

These towns represent the majority of Water Corporation's South West customers and make up 65 per cent of total water demand.

While the majority of land is cleared for agricultural and urban uses, the Swan Coastal Plain in the study area does include approximately 100 wetlands. Significant examples include the Vasse-Wonnerup (a Ramsar wetland), Benger Swamp and Toby Inlet.

The Swan Coastal Plain has high superficial groundwater levels and rainfall often ponds or floods. CSIRO modelling indicates groundwater levels may be unchanged up to 2030, under a range of drying climate scenarios, until winter rainfall no longer fully recharges the superficial aquifer.

The Swan Coastal area is considered susceptible to salt water intrusion — particularly in the northern area near Bunbury.

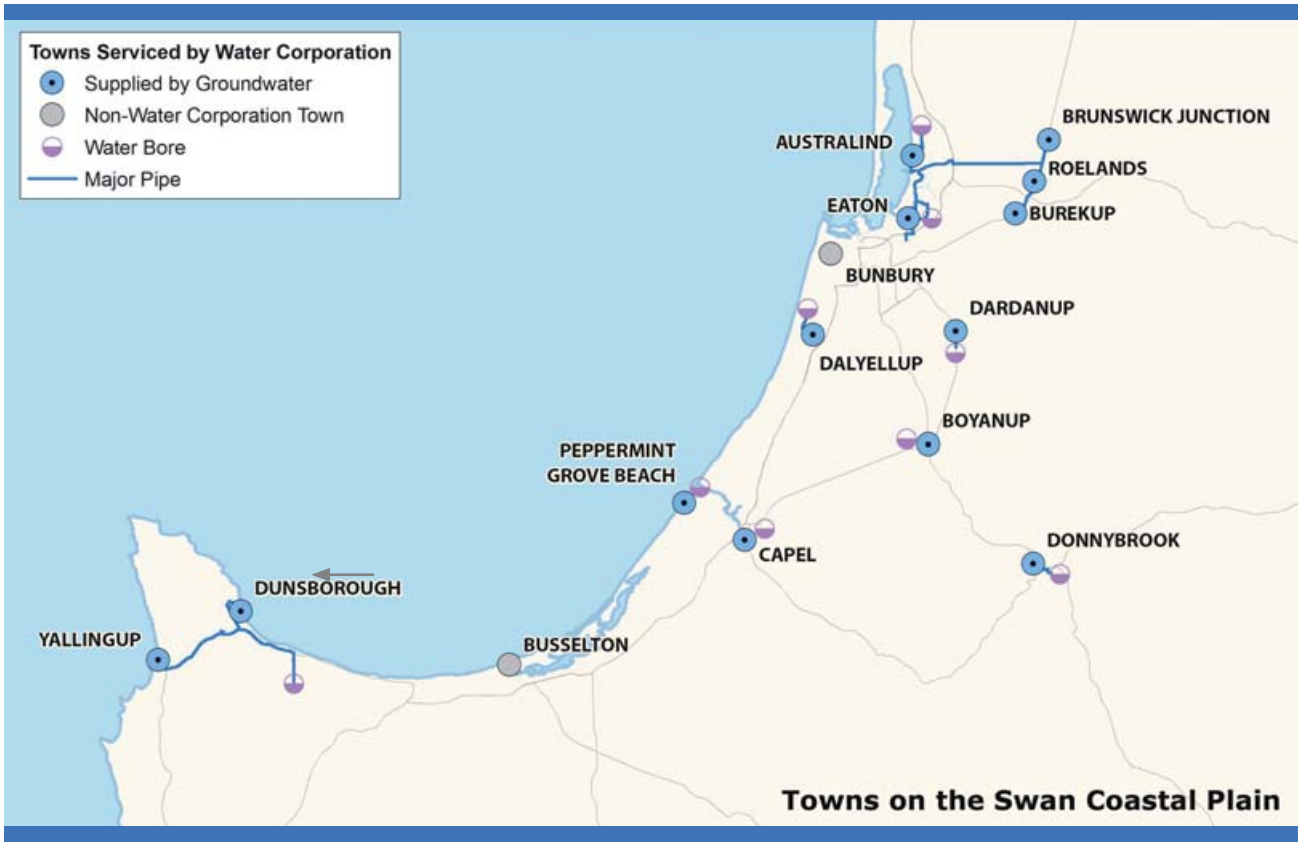
These coastal areas have been growing rapidly with many new urban developments and almost 80 per cent of future growth expected in this area — particularly around Eaton-Australind and in the Greater Bunbury area.

The towns are supplied by groundwater from the Yarragadee, Leederville or Sue Coal Measures aquifers and we have existing allocations of 12.8 billion litres.

There is an additional 16 billion litres reserved for future town water supplies for Aqwest, Busselton Water and Water Corporation supplied towns. We estimate this is sufficient to meet demands in this area to between 2040 and 2060 for Bunbury and Busselton respectively, unless groundwater allocations are reduced due to a drying climate.

The area includes the key wastewater treatment plants of Bunbury, Busselton and Kemerton which treat about 70 per cent of wastewater flows in the South West and present the most viable opportunities for large-scale water recycling.

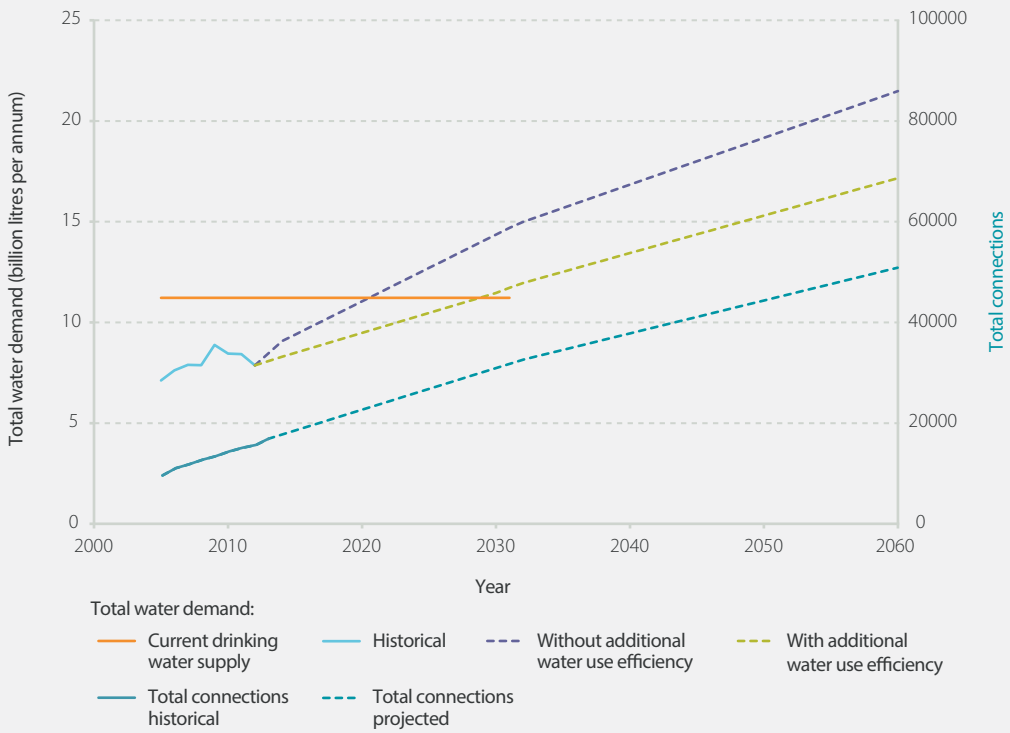
Groundwater replenishment is considered most viable at Bunbury due to the larger wastewater flows available and the existing ocean outfall for brine disposal.



There have been a number of water efficiency campaigns in the Swan Coastal Plains area and gains have been made. However, per capita water use in those towns remains higher than other towns in the South West and there are opportunities to make further water use efficiency improvements.

Achieving these water efficiency gains will delay the need for major new sources until after 2030 (see Figure 12).

Figure 12 Projected water demand on the Swan Coastal Plain, with and without additional water use efficiency measures



Note: Water Corporation customers along the Coastal Plain are from Eaton to Yallingup excluding Bunbury and Busselton.

Options for Towns on the Swan Coastal Plain

Bunbury Yarragadee Groundwater Expansion

Current situation	Water Corporation is licensed to take up to 6.6 billion litres from the Yarragadee and Leederville aquifers to provide drinking water for an estimated population of 27,400.
Description of source option	This option involves constructing: • two new Yarragadee groundwater bores, south of the Picton Water Treatment Plant • approximately 13.5 kilometres of pipeline, and • a second treatment module at the Picton Water Treatment Plant.
Towns supplied	Eaton, Australind, Roelands, Brunswick Junction and Greater Bunbury area
Potential additional yield per year	4.7 billion litres (from the public water supply reserves)
Potential timing	Long-term option — a new source is required before annual demand reaches 6.6 billion litres, which is estimated to be around 2035
Benefits	• Can be staged to meet demand • Groundwater is close to rapidly growing areas of Eaton-Australind and Greater Bunbury • Local water source ensures minimal pumping, piping and less energy usage • Water is already set aside in the 'public water reserves'
Issues	• Public water supply reserve may not be available when needed • Groundwater allocation may be reduced

Dalyellup Groundwater Treatment Plant Upgrade

Current situation	Water Corporation is licensed to take 1.77 billion litres from Yarragadee bores to provide drinking water for an estimated population of 5,600. However, the capacity of the water treatment plant is insufficient to meet growing demand.
Description of source option	This option involves upgrading the existing Dalyellup Groundwater Treatment Plant to a capacity of 12 million litres per day. A new Yarragadee bore has been drilled but needs to be fitted and equipped.
Towns supplied	Dalyellup
Potential additional yield per year	No additional yield
Term/timing	This option is currently under investigation
Benefits	• Uses existing groundwater bores • Local water source ensures minimal pumping, pipes and less energy usage
Issues	• In the long term, managing salt water intrusion into the aquifer in the Bunbury area, however the new bore has been drilled further inland to mitigate this issue

Kemerton North Leederville Borefield

Current situation	There currently are no drinking water bores in the Kemerton area.
Description of source option	This option involves creating a borefield in the Kemerton North area to access the Leederville Aquifer, and providing the necessary infrastructure to adequately treat the water. It would require constructing: • 15 bores • 20 kilometres of pipeline • a high level water treatment plant, and • 21 kilometres of conveyance pipeline to integrate the water into the Eaton-Australind scheme.
Towns supplied	Eaton, Australind, Roelands, Brunswick Junction and Greater Bunbury area
Potential additional yield per year	3 billion litres (from the public water supply reserves)
Term/timing	Long-term option — a new source is required before annual demand reaches 6.6 billion litres, which is estimated to be around 2035
Benefits	• Water is already set aside in the public water supply reserves
Issues	• Water from this aquifer has elevated salinity levels so either additional treatment, or blending, would be required to ensure acceptable water quality level • Pipeline routes are environmentally constrained

Boyanup Groundwater Expansion

Current situation	Water Corporation is licensed to take up to 325 million litres per year from two Yarragadee bores to provide drinking water for approximately 840 people.
Description of source option	This option involves expanding the groundwater scheme by: • constructing an additional Yarragadee bore and 5 kilometres of pipeline, and • upgrading the existing water treatment plant.
Towns supplied	Boyanup
Potential additional yield per year	100 million litres (from the public water supply reserves)
Term/timing	Long-term option – not likely to be required before 2040
Benefits	• Only small volumes of local groundwater required to meet population growth • Local water source ensures minimal pumping, pipes and less energy usage • Water is already set aside in the public water reserves
Issues	• Public water supply reserve may be used first by the Greater Bunbury area • Groundwater allocation may be reduced

Capel–Donnybrook–Peppermint Grove Beach Groundwater

Current situation	Water Corporation is licensed to take: • 450 million litres from Capel–Yarragadee bores • 450 million litres from Donnybrook–Leederville bores, and • 150 million litres from Peppermint Grove Beach–Yarragadee bores. This provides drinking water for an estimated population of 5,000.
Description of source option	The option involves constructing two Yarragadee bores, one west of Donnybrook and the other east of Capel, with a pipeline connection to Peppermint Grove Beach. In addition to the bores, it involves constructing: • water treatment plants • 6 kilometres of pipeline from Capel, and • 3.5 kilometres of pipeline from Donnybrook. An alternative option is to develop an integrated scheme connecting all three towns.
Towns supplied	Capel, Donnybrook and Peppermint Grove Beach
Potential additional yield per year	1.1 billion litres (from public water reserves)
Term/timing	Medium-term option — required before annual demand reaches 400 million litres, which is estimated to be around 2020
Benefits	• Only small volumes of local groundwater required to meet population growth • Local water source ensures minimal pumping, pipes and less energy usage • Water is already set aside in the public water reserves
Issues	• Capel may grow faster than expected making it necessary to develop this source sooner • Groundwater allocation may be reduced • Donnybrook townsite growth may increase faster than expected once the Shire of Donnybrook-Balingup's local 50 year planning strategy has been finalised

Capel Micro Seawater Desalination Plant

Current situation	There are no micro seawater desalination plants in the South West. The Southern Seawater Desalination Plant near Binningup does not supply water to the South West.
Description of source option	This option involves constructing a micro desalination plant south of Peppermint Grove Beach, with intake and outlet structures into Geographe Bay. It would also require at least 150 kilometres of pipeline and associated infrastructure.
Towns supplied	Peppermint Grove Beach, Capel and the Warren-Blackwood Regional Water Supply Scheme that supplies Bridgetown, Nannup and Manjimup. Could be expanded to supply other towns such as Dunsborough-Yallingup and Margaret River if required.
Potential additional yield per year	Up to 8 billion litres
Term/timing	Long-term option – unlikely to be required before 2050
Benefits	• Climate independent water source • Can be scaled to provide a regional climate independent source
Issues	• Extensive community consultation required • Extensive environmental approvals required • Pipeline distances are large resulting in high pipeline costs and ongoing energy consumption

West Coast Micro Seawater Desalination Plant

	This option is described in more detail under the Margaret River-Augusta area, page 54.
Description of source option	Construction of a micro desalination plant on the west coast between Yallingup and Indijup with intake and outlet structures into the ocean.
Towns/schemes supplied	Dunsborough-Yallingup scheme Margaret River-Cowaramup scheme

Southern Seawater Desalination Plant

Current situation	The Southern Seawater Desalination Plant is located near Binningup and can produce up to 100 billion litres of water a year. The desalinated water is supplied to the Integrated Water Supply Scheme (IWSS) which supplies water from north of Perth to south of Mandurah and out to the Goldfields region. All water from the Southern Seawater Desalination Plant currently is used to support the IWSS. This may change if: • there is excess water in dams such as Stirling, Harris and the Dandalups dams • additional work is undertaken to increase the treatment capacity of the desalination plant, such as more pre-treatment or brine recovery to maximise water production.
Description of source option	This option involves constructing more than 85 kilometres of pipeline, and associated pumps and storage tanks, to allow drinking water from the Southern Seawater Desalination Plant to be supplied to areas such as Eaton-Australind as well as Dardanup, Boyanup and Donnybrook if required.
Towns supplied	Eaton-Australind and Greater Bunbury area
Potential additional yield per year	8.8 billion litres
Term/timing	Long-term option – dependent on changes to IWSS
Benefits	• Climate independent water source • Allows optimisation of existing infrastructure
Issues	• May require improvements in desalination technology as current plant is at full capacity • Water availability may be dependent on water levels for Perth IWSS (Stirling Dam and the North, South and Lower Dandalup dams) • Pipeline routes from Binningup to Eaton-Australind are environmentally constrained

Bunbury Groundwater Replenishment

Current situation	There are no groundwater replenishment schemes in the South West. Australia's first full-scale groundwater replenishment scheme in Perth is expected to begin recharging in late-2016.
Description of source option	This option involves constructing an advanced water recycling plant to take highly treated wastewater from the Bunbury Wastewater Treatment Plant, treat it to drinking water standard, and then recharge it into groundwater supplies. The water can be stored and taken out some time later for further treatment and supply to a drinking water system. It would also require a recharge bore, abstraction bores and a water treatment plant.
Towns supplied	Greater Bunbury area
Potential additional yield per year	The actual volume of wastewater available for recycling depends on population growth in the Bunbury area, however an estimated 6 billion litres per year could be recharged into the aquifer by 2060.
Term/timing	Long-term option – unlikely to be required before 2040
Benefits	• Climate independent water source • Aquifer acts as storage facility and groundwater levels are replenished • Operational costs are less than desalination • Existing ocean outfall can be used for brine disposal
Issues	• Substantial investigations required • Regulatory approvals from the Department of Health, Department of Environment Regulation, and the Department of Water estimated to take 8 years • Extensive community consultation and support required

Busselton Groundwater Replenishment

Current situation	There are no groundwater replenishment schemes in the South West. Australia's first full-scale groundwater replenishment scheme in Perth is expected to begin recharging in late-2016.
Description of source option	This option involves constructing an advanced water recycling plant to take highly treated wastewater from the Busselton Wastewater Treatment Plant, treat it to drinking water standard, and then recharge it into groundwater supplies. The water can be stored and taken out some time later for further treatment and supply to a drinking water system. It would also require three recharge bores, abstraction bores, a water treatment plant and approximately 27 kilometres of pipeline.
Towns supplied	Greater Busselton area
Potential additional yield per year	The actual volume of wastewater available for recycling depends on population growth in the Busselton area however an estimated 3.2 billion litres per year may be available by 2060
Term/timing	Long-term option — unlikely to be required before 2060
Benefits	• Climate independent water source • Aquifer acts as storage facility and groundwater levels are replenished • Operational costs are less than desalination
Issues	• Substantial investigations required • Regulatory approvals from the Department of Health, Department of Environment Regulation, and the Department of Water estimated to take 8 years • Extensive community consultation and support required • Approval of suitable brine disposal option from water recycling plant (for example an ocean outfall) • Water Corporation does not supply water in Busselton but this could supplement the Dunsborough-Yallingup scheme

Busselton Wastewater Treatment Plant

Bulk Water Agreement with Busselton Water

In 2010, we signed a long-term water transfer agreement with Busselton Water. Under the agreement, Busselton Water sells water to us to supplement the Dunsborough-Yallingup water supply. This arrangement was the most cost effective way to meet peak demand, and allows for the effective use of existing infrastructure.

Busselton Water's existing groundwater allocation from the Department of Water is 8.1 billion litres per year, and it currently uses 4.6 billion litres per year. Busselton Water has indicated there is scope to provide additional water to us and this is one of our long-term options.

Any additional agreements for bulk water transfers to other areas would be negotiated on a case-by-case basis.

Bulk Water Agreement with Aqwest

We are investigating the option of a bulk water agreement with Aqwest.

Aqwest supplies water to the Bunbury area and has a groundwater allocation from the Department of Water of 7.6 billion litres per year, of which 6.3 billion litres per year is currently used.

There is the potential for Aqwest to sell us water to meet demand, particularly in Dalyellup where there is a relatively small distance between the infrastructures of the two utilities.

We have interconnected the pipelines between Dalyellup and Bunbury to secure future water supply and safeguard against potential breakdowns with the water source.

Water trade from the Swan Coastal Plain

The Department of Water's policy restricts water trades to the same aquifer and same groundwater sub-area.

Local landholders have identified that water may become available for trading in the Dunsborough-Vasse sub-area in the Leederville Aquifer as rural lots are developed into landholdings, or through changes in agricultural practices. A review of existing groundwater licences highlighted that more than one trade may be needed to reach a feasible volume of water, making this a challenging option. There would also be water quality issues to consider.

The traded water could be used to supply the Dunsborough-Yallingup scheme. Our initial investigations indicate that a minimum of 600 million litres per year would be needed to make this option viable. If this volume is available for trading, two additional bores would need to be constructed, along with an upgrade to the water treatment plant and associated pipeline.

Brunswick River Dam

The Brunswick River is located approximately 20 kilometres north of Bunbury, near Brunswick Junction, and flows into the Leschenault Estuary. There are several possible water source development options ranging from a small dam to a major large dam that have been assessed over many years. However in 2013, the government removed the drinking water protection zoning from this area, and is not planning to make this a drinking water source.

This option is highly dependent on rainfall and would require additional investment in water treatment due to water quality issues in the catchment area. There are also significant social and environmental considerations including clearing of native vegetation, inundation of the river valley, impacts on private landowners in the catchment area, impacts on flora and fauna and possible loss of recreational and social values in the area.

Brunswick River Dam is not included as a future water source option.

Collie area

Collie and Allanson are supplied from the Great Southern Towns Water Supply Scheme (GSTWSS) and are supplied primarily from Harris Dam. Water supply to Collie can also be supplemented by the local water source, Mungalup Dam.

Collie was identified as a SuperTown under the State Government's program and aims to diversify from mining into other industries. The strategy includes a focus on tourism and recreational activities leveraging off Wellington Dam, surrounding national parks and state forest.

Wellington Dam is the largest dam in the South West. Due to high salinity levels, it ceased being used as a drinking water source in the 1990s. Like other surface water sources in the South West, Wellington Dam has seen a reduction in inflows. The State Government has designated Wellington Dam as a strategic source for industry, agriculture and recreation.

Figure 13 outlines projected water demand in Collie and shows that total water use has been decreasing in recent years. A targeted water use efficiency program is currently underway for residential and commercial customers to further reduce water demand.

Total water demand for the area is approximately 1.1 billion litres supplying a population of about 8,200 and demand is estimated to increase to about 1.8 billion litres.

There is more than sufficient capacity in Harris Dam to meet Collie's long-term water demand. Even allowing for additional growth in the GSTWSS and further climate reductions in inflow, additional water is not likely to be required before 2030.

However, like other surface water schemes, a series of dry winters will put the scheme at risk of having insufficient water. The record breaking dry years of 2010 and 2012 highlighted this vulnerability although the recent 2013 winter rainfall has restored the dam to safe storage levels.

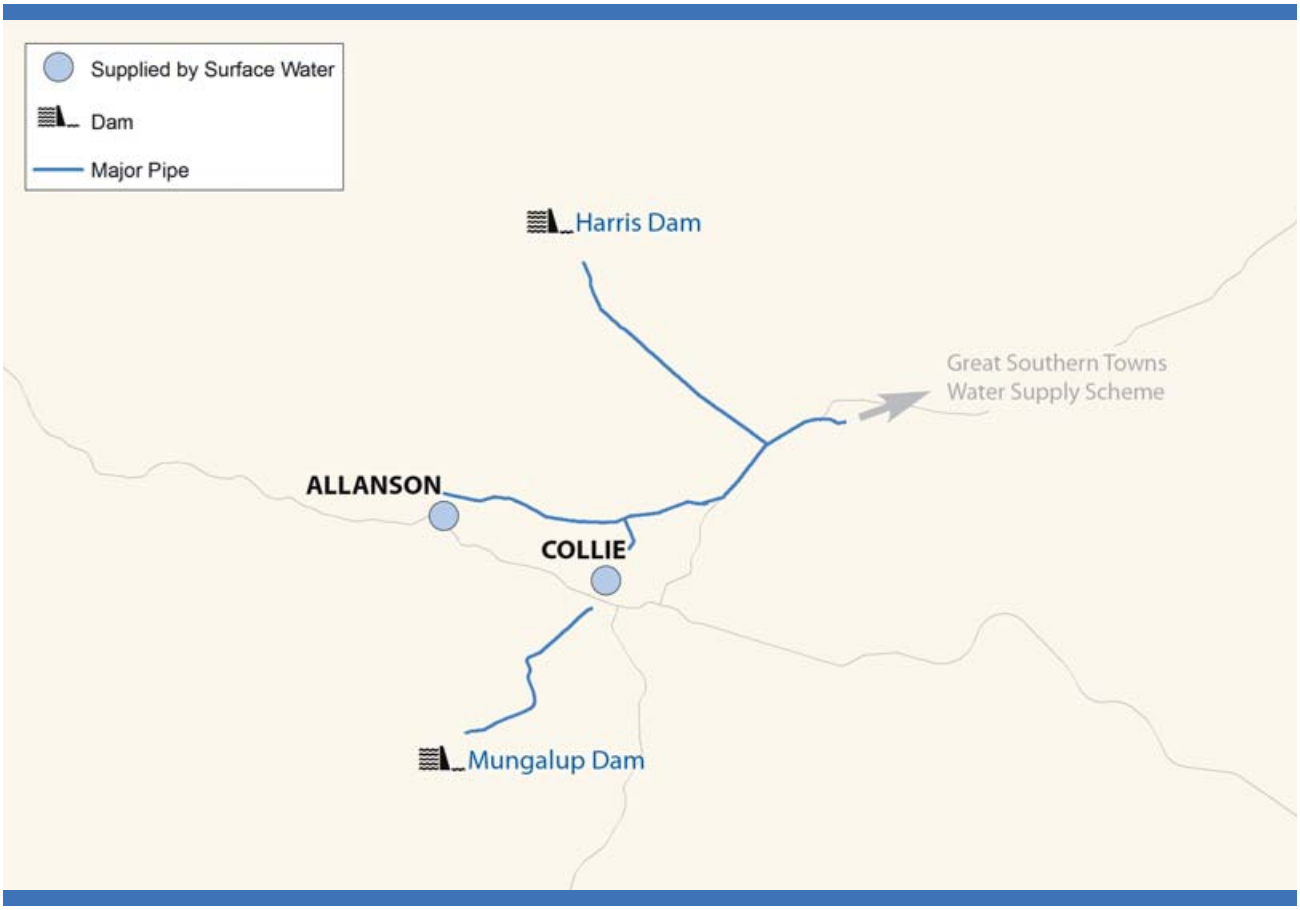
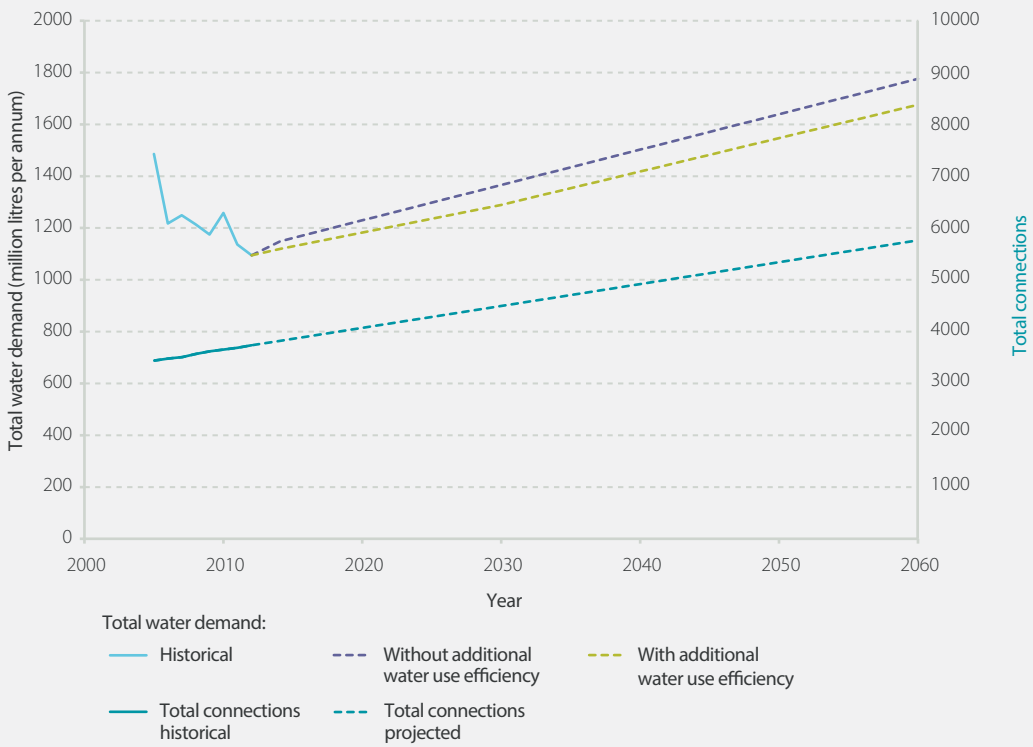


Figure 13 Projected water demand for Collie, with and without water use efficiency measures



Options for the Collie area

We are investigating an option to connect the Stirling Dam to Harris Dam and the Great Southern Towns Water Supply Scheme. This would provide additional water security for the scheme. If a continuing drying climate meant that both Stirling and Harris dams are not enough to supply the GSTWSS in the future, an option may be to transfer water from the Southern Seawater Desalination Plant near Binningup via Stirling Dam to Harris Dam (see page 69).

Note: Harris Dam provides water to the Great Southern Town Water Supply Scheme. The graph above does not show the capacity of Harris Dam which is 71 billion litres.

Stirling Dam Connection

Current situation	Stirling Dam provides water to the Perth Integrated Water Supply Scheme and Harris Dam is the main supply to the Great Southern Towns Water Supply Scheme (GSTWSS). There is a pipeline to provide water from Harris Dam into the back of Stirling Dam catchment.
Description of source option	This option involves constructing approximately 10 kilometres of pipeline and a pump station at Stirling Dam to allow water to be transferred from Stirling Dam to Harris Dam.
Towns supplied	GSTWSS supplies water to 44 towns from Collie, east to Lake Grace and south to Tambellup
Term/timing	We are currently investigating this option. Investigations on a preferred pipeline route and environmental approvals are well underway to ensure the project is 'construction ready' and can be quickly initiated if a series of dry winters reduce storage levels to unacceptable levels.
Benefits	• Intregration will provide improved water security for the whole GSTWSS • Allows integration of water from the Southern Seawater Desalination Plant near Binningup via Stirling Dam to Harris Dam in the future if required
Issues	• Susceptible to dry winters • Environmental approvals required

Collie Groundwater Replenishment

Current situation	There are no groundwater replenishment schemes in the South West. Australia's first full-scale groundwater replenishment scheme in Perth is expected to begin recharging in late-2016.
Description of source option	This option involves constructing an advanced water recycling plant to take highly treated wastewater from the Collie Wastewater Treatment Plant, treat it to a drinking water standard, and then recharge it into groundwater supplies. The water can be stored and taken out some time later for further treatment and supply to a drinking water system. It would also require recharge bores, abstraction bores and a water treatment plant. The brine would be diverted to evaporation ponds at the water treatment plant.
Towns supplied	Collie and Allanson
Potential additional yield per year	The actual volume of wastewater available for recycling is subject to population growth in the Collie area, however, an estimated 860 million litres per year of wastewater will be available by 2060.
Term/timing	Long-term option – not likely to be required before 2060
Benefits	• Climate independent water source • Aquifer acts as storage facility and groundwater levels are replenished • Operational costs are less than desalination
Issues	• Substantial investigations required • Regulatory approvals from the Department of Health, Department of Environment Regulation, and the Department of Water estimated to take 8 years • Extensive community consultation and support required • Brine disposal would be a significant issue to overcome

Wellington Dam

Wellington Dam

Wellington Dam has not been used as a drinking water source since 1990 due to high salinity levels.

Like other dams in the South West, the reduction in rainfall has resulted in a decrease in consistent inflows to Wellington Dam and reduced its reliability as a water source.

To ensure long-term water security for agriculture and industry, the State Government has reserved Wellington Dam solely for agriculture, industry and recreation.

Some stakeholders who commented on the draft report were disappointed Wellington Dam was not considered as a future drinking water source and wanted to see the salinity improved.

Information on salinity recovery projects is available from the Department of Water.

Wellington Dam is not included as a future water source option.

Collie Basin groundwater

There are significant volumes of groundwater in the Collie Basin with large amounts abstracted to lower the water table for coal mining. Some of this mine dewater is used onsite for dust suppression, some is used by power generators and the remainder is returned to the environment. The option of using mine dewater as a drinking water source is challenging due to highly variable volumes of water and water quality issues.

Should a volume of groundwater be available, we would consider this option.

At this stage, Collie groundwater is not considered a future water source option.

Margaret River–Augusta area

The Margaret River–Augusta area includes: Augusta, Margaret River, Cowaramup, Prevelly and Gnarabup.

An internationally recognised tourism and wine region, this area sits on top of the Blackwood plateau. There are large areas of native forest, groundwater dependent ecosystems such as the Reedia wetlands, the Margaret River and the Blackwood River. CSIRO modelling projects that groundwater levels on the Blackwood plateau are most likely to be impacted by the drying climate.

The Margaret River Water Supply Scheme provides water to the towns of Margaret River, Cowaramup, Prevelly and Gnarabup. These areas have been growing rapidly and, if this continues, the population is estimated to triple by 2060. Margaret River has also been included as a State Government SuperTown.

The Margaret River scheme's total water demand is approximately 1 billion litres per year with water supplied from Ten Mile Brook Dam and a Yarragadee bore. We will continue to use both water sources, capturing run-off in the dam when rainfall permits. While there are sufficient average yields to ensure water demand is met until about 2030, the scheme is susceptible to a series of dry winters which may impact the timing of new water sources.

There was a reduction in average water use per person as a result of a targeted water use efficiency program in 2009. We have assumed that these savings will be maintained in the future. There is opportunity for further efficiencies and, if these are achieved, the timing for developing new sources would be delayed.

Augusta has not shown the same population growth although peak tourism times display a significant increase in water demand.

Augusta is supplied by groundwater from the Lesuer Sandstone Aquifer. Total water demand is 265 million litres per year for an estimated population of 2,200.

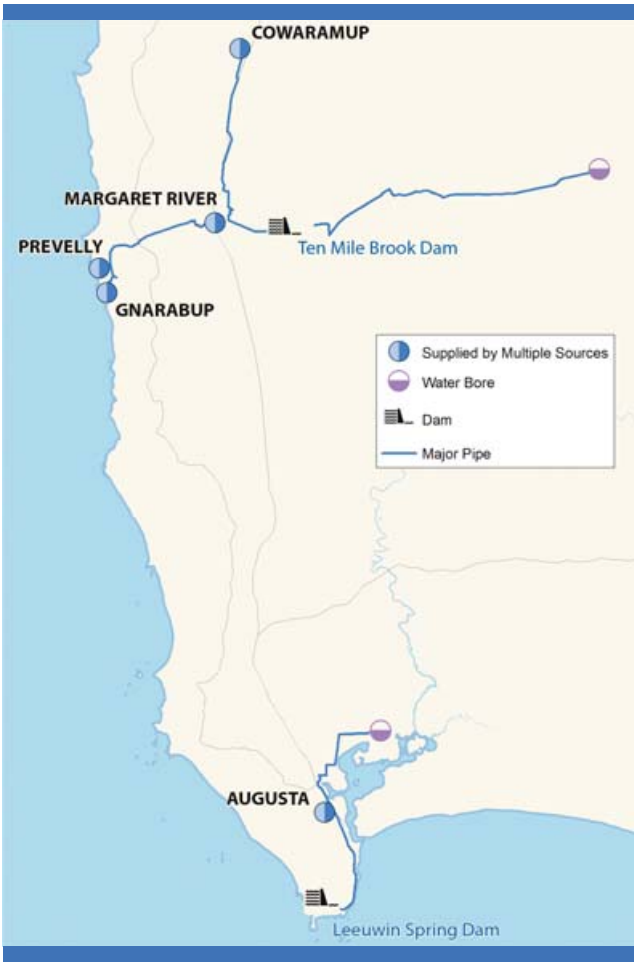
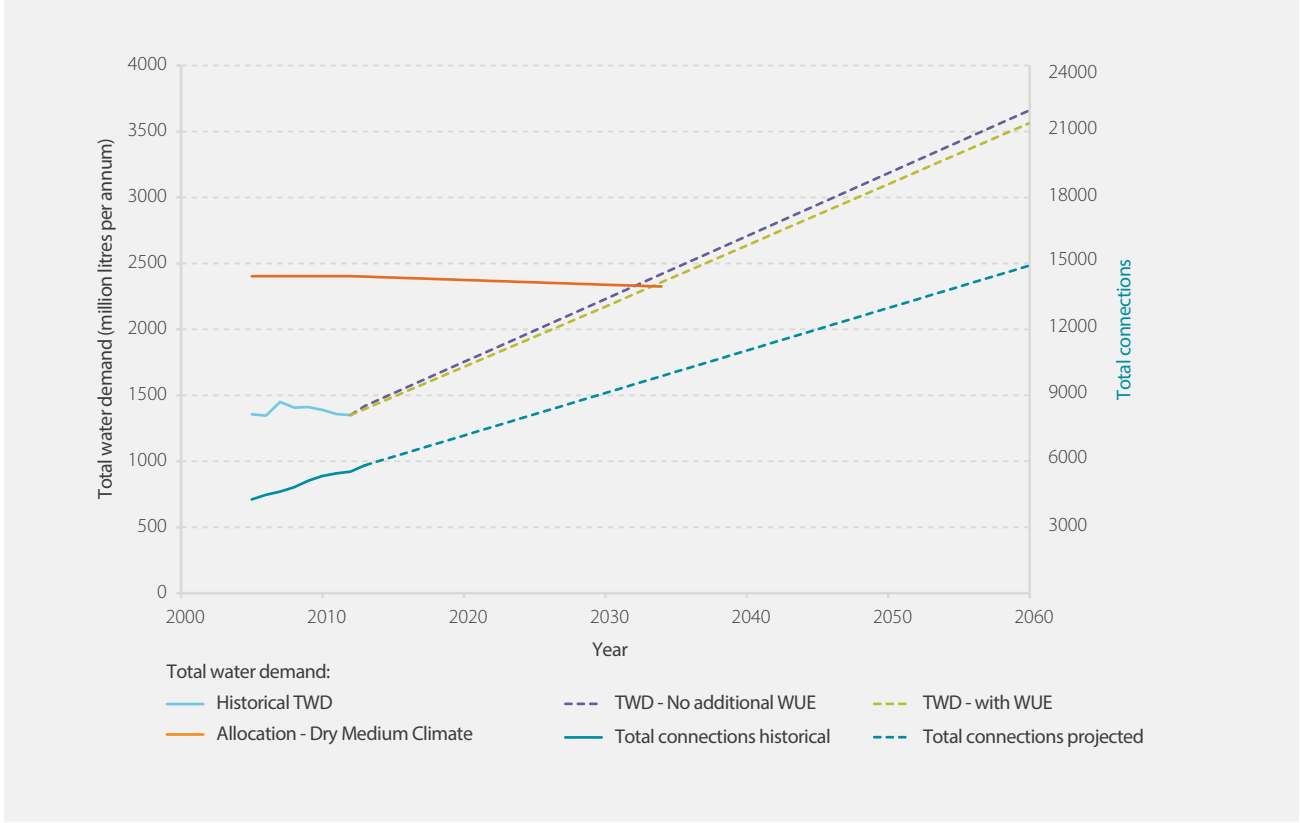


Figure 14 Projected water demand for Margaret River–Augusta area with and without water use efficiency measures



Options for the Margaret River-Augusta area

Augusta Groundwater Expansion

Current situation	Water Corporation is licensed to take 400 million litres per year from the Lesueur Sandstone, which is sufficient to meet average total demand until 2040. As Augusta's water demand shows a significant increase over the summer tourist period, additional infrastructure may be required to meet peak demands in the short term.
Description of source option	This option requires approval to access the existing Lesueur Sandstone public water reserve of 500 million litres per year post-2040. This would meet demand until at least 2060. A new bore already has been approved and drilled (but not yet equipped) at the eastern end of Fisher Road to help meet peak demand, so no additional bores would be required. This option would involve an upgrade to the water treatment plant and construction of an additional 2 kilometres of pipeline.
Towns supplied	Augusta
Potential additional yield per year	500 million litres (from the public water reserve)
Term/timing	Upgrades to meet peak demands are currently under investigation. Increase in groundwater allocation is not likely to be required before 2040.
Benefits	• Uses local groundwater so minimal pipelines, pumping and energy usage • Uses existing assets • Uses water from the public groundwater reserves
Issues	• Faster than expected growth will require timings to be readjusted • Groundwater allocation may be reduced

Margaret River Groundwater Expansion

Current situation	Water Corporation is licensed to take up to 1.6 billion litres per year from Yarragadee bores for the Margaret River water supply scheme.
Description of source option	This option involves expanding the groundwater scheme to take groundwater from the public water reserves in the Busselton-Capel sub-area. It would require: • a new Yarragadee bore • additional 7 kilometres of pipeline • an upgrade to the water treatment plant, and • depending on bore production rates, a second Yarragadee bore located north on Sue's Road with additional pipeline.
Towns supplied	Margaret River, Cowaramup, Prevelly and Gnarabup
Potential additional yield per year	Up to 1.6 billion litres by 2060
Term/timing	Medium-term option — not likely to be required before 2030
Benefits	• Uses local groundwater so minimal pipelines, pumping and energy usage • Uses water from the public water reserves
Issues	• Community concern over use of the Yarragadee Aquifer • Community concern over impacts of the drying climate on the Blackwood River • Approval for a new groundwater bore and licence likely to take several years of planning

Margaret River Leederville Borefield

Current situation	There are no existing drinking water bores in the Leederville Aquifer for the Margaret River scheme.
Description of source option	This option involves developing a new borefield to access unallocated groundwater from the Leederville Aquifer in the Cowaramup and Rosa sub-areas. It would require: • 4 production bores — 3 in the Cowaramup sub-area and 1 in the Rosa sub-area • approximately 8 kilometres of pipeline, and • an upgrade to the water treatment plant.
Towns/schemes supplied	Margaret River, Cowaramup, Gnarabup, Prevelly
Potential additional yield per year	Up to 900 million litres, subject to additional hydrogeological investigations
Term/timing	Medium-term option — not likely to be required before 2030
Benefits	• Groundwater is located close to the demand centre of Margaret River so limited pipelines and pumping • Avoids using the Yarragdee Aquifer
Issues	• Requires access to groundwater that is currently unallocated • Not guaranteed that this groundwater will remain unallocated in the long term • Possible community concern about using unallocated water rather than water from the public water reserves • Leederville Aquifer is already used and is smaller than the Yarragadee Aquifer

Margaret River Groundwater Replenishment

Current situation	There are no groundwater replenishment schemes in the South West. Australia's first full-scale groundwater replenishment scheme in Perth is expected to begin recharging in late-2016.
Description of source option	This option involves construction of an advanced water recycling plant to take highly treated wastewater from the Margaret River Wastewater Treatment Plant, treat it to a drinking water standard, and then recharge it into groundwater supplies. The water can be stored and taken out some time later for further treatment and supply to a drinking water system. It would require a recharge bore, two abstraction bores, 22 kilometres of pipeline and water plant. The brine would be diverted to evaporation ponds at the water treatment plant. The options for disposing of the brine produced are: • using evaporation ponds, or • building an ocean outfall into the Ngari Capes Marine Park.
Towns supplied	Margaret River, Cowaramup, Gnarabup and Prevelly
Potential additional yield per year	The actual volume of wastewater available for recycling is dependent on population growth, however, it is estimated that by 2060 approximately 1.12 billion litres per year of wastewater will be available.
Term/timing	Long-term option – not likely to be required before 2050
Benefits	• Climate independent water source • Aquifer acts as storage facility and groundwater levels are replenished • Operational costs are less than desalination
Issues	• Substantial investigations required • Regulatory approval from the Department of Health, Department of Environmental Regulation and Department of Water estimated to take 8 years • Brine disposal likely to be challenging with evaporation ponds technically difficult. An ocean outfall would require additional environmental approvals and community consultation.

West Coast Micro Seawater Desalination Plant

Current situation	There are no micro seawater desalination plants in the South West. The Southern Seawater Desalination Plant near Binningup does not supply water to the South West.
Description of source option	This option involves constructing a micro desalination plant on the west coast between Yallingup and Indijup, with intake and outlet structures within the Ngari Capes Marine Park, as well as approximately 50 kilometres of pipeline.
Towns/schemes supplied	Dunsborough-Yallingup scheme Margaret River,Cowaramup, Gnarabup and Prevelly
Potential additional yield per year	Up to 4 billion litres
Term/timing	Long-term option – not likely to be required before 2050
Benefits	• Climate independent water source • Close to demand centres of Dunsborough and Margaret River
Issues	• Extensive community consultation required • Extensive environmental approvals required

South Coast Micro Seawater Desalination Plant

Current situation	There are no micro seawater desalination plants in the South West. The Southern Seawater Desalination Plant near Binningup does not supply water to the South West.
Description of source option	This option involves constructing a micro desalination plant south of Augusta, with inlet and outlet structures, as well as approximately 120 kilometres of pipeline and associated pumps.
Towns supplied	Margaret River, Cowaramup, Gnarabup, Prevelly and Augusta Karridale and Witchcliffe are possible connections
Potential additional yield per year	2 billion litres
Term/timing	Long-term option – not likely to be required before 2050
Benefits	• Climate independent • Southern coastline is highly active and well suited for brine disposal
Issues	• Topography will require considerable engineering work • Location is considerable distance from the main demand centre of Margaret River • Limited access to power

Warren-Blackwood area

The Warren-Blackwood area includes: Bridgetown, Balingup, Boyup Brook, Greenbushes, Hester, Kirup, Manjimup, Mullalyup and Nannup. Manjimup has been earmarked by the State Government as a SuperTown.

There are large areas of state forest and cleared areas for agriculture, with some key industries including: timber harvesting, mining, agriculture, horticulture and viticulture.

The area is east of the Darling Fault with Nannup located just to the east of the groundwater basin outlined in the *South West Groundwater Areas Allocation Plan*. Outside of the groundwater basin, there is limited localised groundwater and the area is dominated by surface water sources.

The Warren-Blackwood Regional Water Supply Scheme supplies an estimated population of 10,500 from the above towns. The scheme consists of 9 local surface water sources and a groundwater bore that is licensed for up to 1.09 billion litres to be taken from the Yarragadee Aquifer. The current total water demand is less than 1.5 billion litres per year and, subject to population growth, may increase to about 2.4 billion litres in 2060 (see Figure 15).

There has been substantial investment in the Warren-Blackwood scheme including doubling the capacity of Millstream Dam, upgrading Manjimup Dam, constructing a Yarragadee bore and constructing a pipeline from the Yarragadee bore to Manjimup. The construction of a new pipeline from Millstream Dam to Greenbushes is currently underway.

Once the connections to Greenbushes and Kirup are completed, the local sources of Dumpling Gully 1 and 2 and Mullalyup Soak are likely to be used as 'fit for purpose' water sources (for example non-drinking water uses).

The predominance of surface water sources means this scheme is susceptible to the drying climate and a series of dry winters. While there is sufficient drinking water supply to meet the demand until about 2035, a series of dry winters would bring this timing forward.

In this area, the water use per person is lower than other major towns in the South West. This is partly attributable to higher rainfall, lower temperatures and lower evapotranspiration rates, which reduce the need for outdoor garden watering.

A series of major water efficiency programs have been run in the Warren-Blackwood area, including the Rainwater Rewards Rebate scheme in 2012, which was taken up by 60 customers. These water efficiency savings are expected to continue and further gains may delay the need for new water sources to be developed.

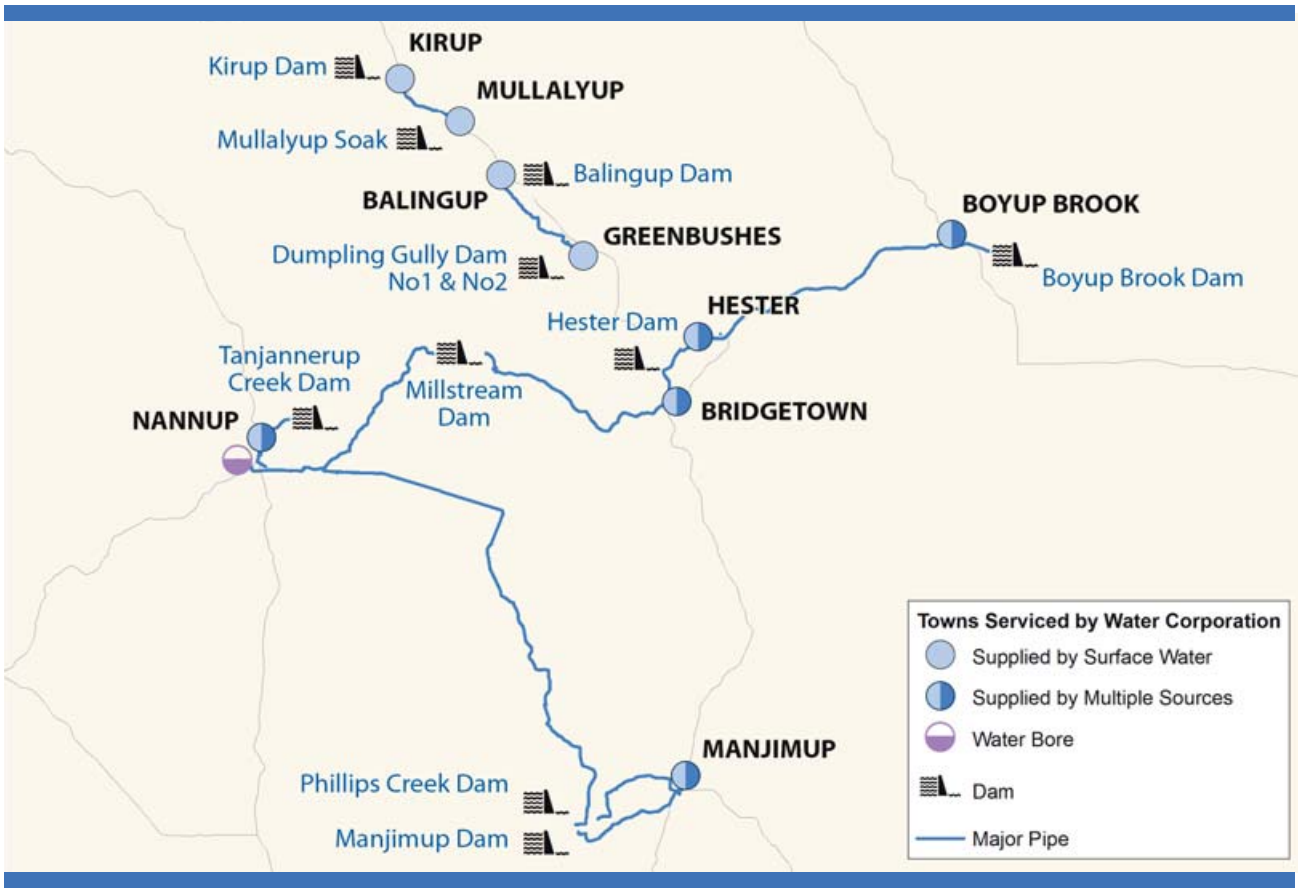
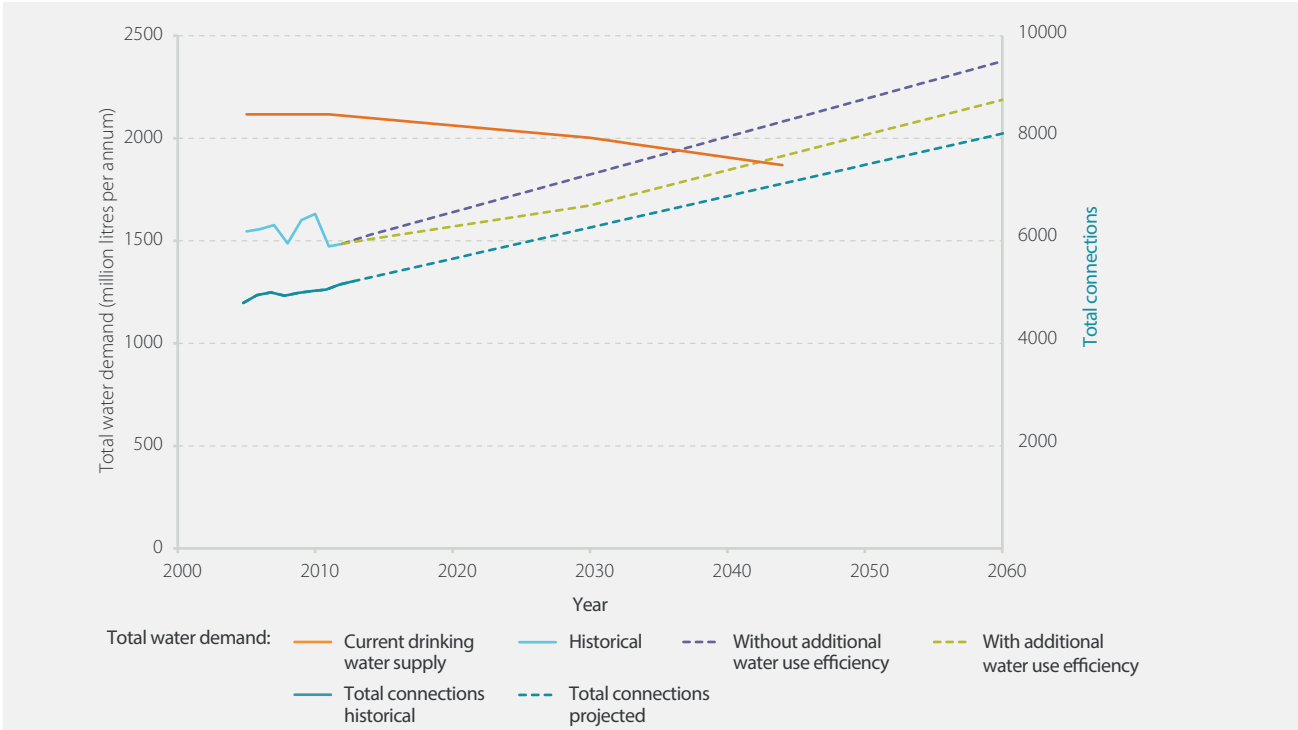


Figure 15 Projected water demands for the towns in the Warren-Blackwood Regional Water Supply Scheme, with and without water use efficiency measures



Options for the Warren-Blackwood area

Camp Creek

Current situation	The Warren-Blackwood Regional Water Supply Scheme currently has 9 dams. There is no dam currently on Camp Creek.
Description of source option	This option involves constructing a small pipe-head dam on Camp Creek, 3 kilometres of pipeline and a pump station to take water to Millstream Dam to supplement the Warren-Blackwood Regional Water Supply Scheme.
Towns supplied	Bridgetown, Balingup, Boyup Brook, Greenbushes, Hester, Kirup and Mullalyup
Potential additional yield per year	Estimated at 300 million litres
Term/timing	Long-term option — timing dependent on rainfall and run-off
Benefits	• Community support for surface water sources
Issues	• Highly dependent on rainfall • Additional investigations required to quantify streamflow volumes • Considerable approvals required • Water quality concerns may require higher levels of treatment

Nannup Brook

Current situation	The Warren-Blackwood Regional Water Supply Scheme currently has 9 dams. There is no dam on Nannup Brook, which is located to the east of Nannup and is a tributary of the Blackwood River.
Description of source option	This option includes constructing a small pipe-head dam on Nannup Brook and approximately 1.8 kilometres of pipeline to pump water back to Millstream Dam to supplement the Warren-Blackwood Regional Water Supply Scheme.
Towns supplied	Bridgetown, Balingup, Boyup Brook, Greenbushes, Hester, Kirup and Mullalyup
Potential additional yield per year	Estimated at 400 million litres
Term/timing	Long-term option — timing dependent on rainfall and run-off
Benefits	• Community support for surface water sources
Issues	• Highly dependent on rainfall • Additional investigations required to quantify streamflow volumes • Water quality concerns may require higher levels of treatment • Land acquisition, Aboriginal heritage and environmental clearances required

Use of non-traditional water sources

For this planning study, we considered the option of increasing recycling of highly treated wastewater for drinking water supplies. In the future, stormwater and brackish groundwater may also be considered as options for drinking water sources.

It may also become more viable to capture, treat and use alternate water sources such as stormwater for wetlands or to supplement the environment, especially as the climate continues to dry. However, there needs to be more research into South West conditions to gain a better understanding of options to artificially supplement water levels to protect ecosystems.

Gregory Brook

Current situation	The Warren-Blackwood Regional Water Supply Scheme currently has 9 dams. There is no dam on Gregory Brook.
Description of source option	This option involves constructing a dam on Gregory Brook with a capacity of 1 billion litres, approximately 1.1 kilometres of pipeline from Millstream Dam to Gregory Brook, and 3.9 kilometres of pipeline to the transfer pump station. Water would be pumped back to Millstream Dam to supplement the Warren-Blackwood Regional Water Supply Scheme.
Towns supplied	Bridgetown, Balingup, Boyup Brook, Greenbushes, Hester, Kirup and Mullalyup
Potential additional yield per year	Estimated at 400 million litres
Term/timing	Long-term option — timing dependent on rainfall and run-off
Benefits	• Community support for surface water sources
Issues	• Dependent on rainfall and the yield is uncertain • Additional investigations required to quantify streamflow volumes • Water quality concerns may require higher levels of treatment

Warren-Blackwood Groundwater Expansion

Current situation	Water Corporation is licensed to take up to 1.09 billion litres per year from the Yarragadee Aquifer. The groundwater bore is used in conjunction with the surface water storages at Nannup, Bridgetown, Manjimup and Greenbushes to ensure a secure water supply for the Warren-Blackwood area.
Description of source option	This option involves expanding the groundwater scheme to allow abstraction of up to 1.91 billion litres from the public water reserves. It would require constructing: • one or two Yarragadee bores towards Cundinup • up to 19 kilometres of pipeline, and • an additional water treatment plant and pump station.
Towns supplied	Nannup, Bridgetown, Manjimup and Greenbushes
Potential additional yield per year	1.91 billion litres (from public water reserves)
Term/timing	Long-term option — timing dependent on rainfall and run-off
Benefits	• Uses local groundwater so minimal pipelines, pumping and energy usage • Uses water from the existing public water reserves • Could be phased in as required • Could be extended to Pemberton, Northcliffe and Quinninup with an additional 72 kilometres of pipeline, which would allow Pemberton's supply to be diversified from a single surface water source
Issues	• Community concern about taking water from the Yarragadee Aquifer • Community concern over the impacts of the drying climate on the Blackwood River • Groundwater allocation may be reduced

Ellis Creek

Ellis Creek has previously been used to pump water back to Millstream Dam as an emergency bore.

Our investigations into this source have highlighted water quality issues with this option, and it also is dependent on rainfall.

This has not been included as a future source option due to water quality concerns.

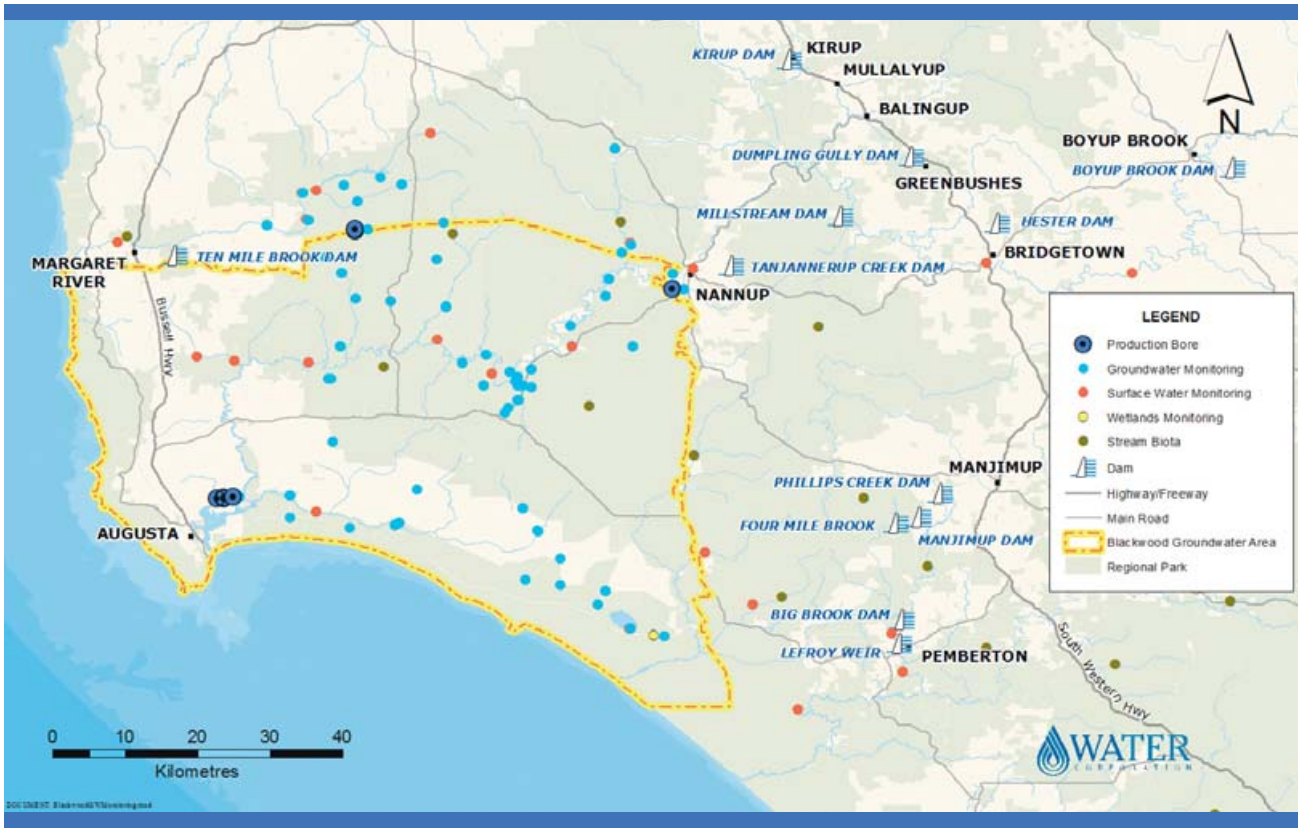
Warren-Blackwood Regional Water Supply Scheme

There also is a potential option to extend the Warren-Blackwood Regional Water Supply Scheme (see page 70).

Environmental water monitoring

The Warren Blackwood Scheme is supplemented with groundwater from Nannup when surface water sources do not fill and demand cannot be met. Significant environmental monitoring is carried out by Water Corporation and the Department of Water in the Blackwood Groundwater Area. This is to ensure groundwater abstraction is not having significant environmental impacts and is sustainable. Figure 16 shows current monitoring by Government in the Blackwood Groundwater Area east of the Bussell Highway.

Figure 16 Water Assets and Monitoring in the Blackwood Groundwater area by Government



Pemberton – Quinninup – Northcliffe area

This area includes Pemberton, Quinninup and Northcliffe.

These towns are known for their magnificent forests, timber harvesting, agricultural produce and cool climate viticulture.

Pemberton is the largest town in this area and we service an estimated population of 850. Over the last five years, growth has been low and water demand is not expected to increase significantly.

Pemberton's drinking water is supplied from Big Brook Dam and Lefroy Weir, which currently overflow. The town's current drinking water demand is approximately 150 million litres per year.

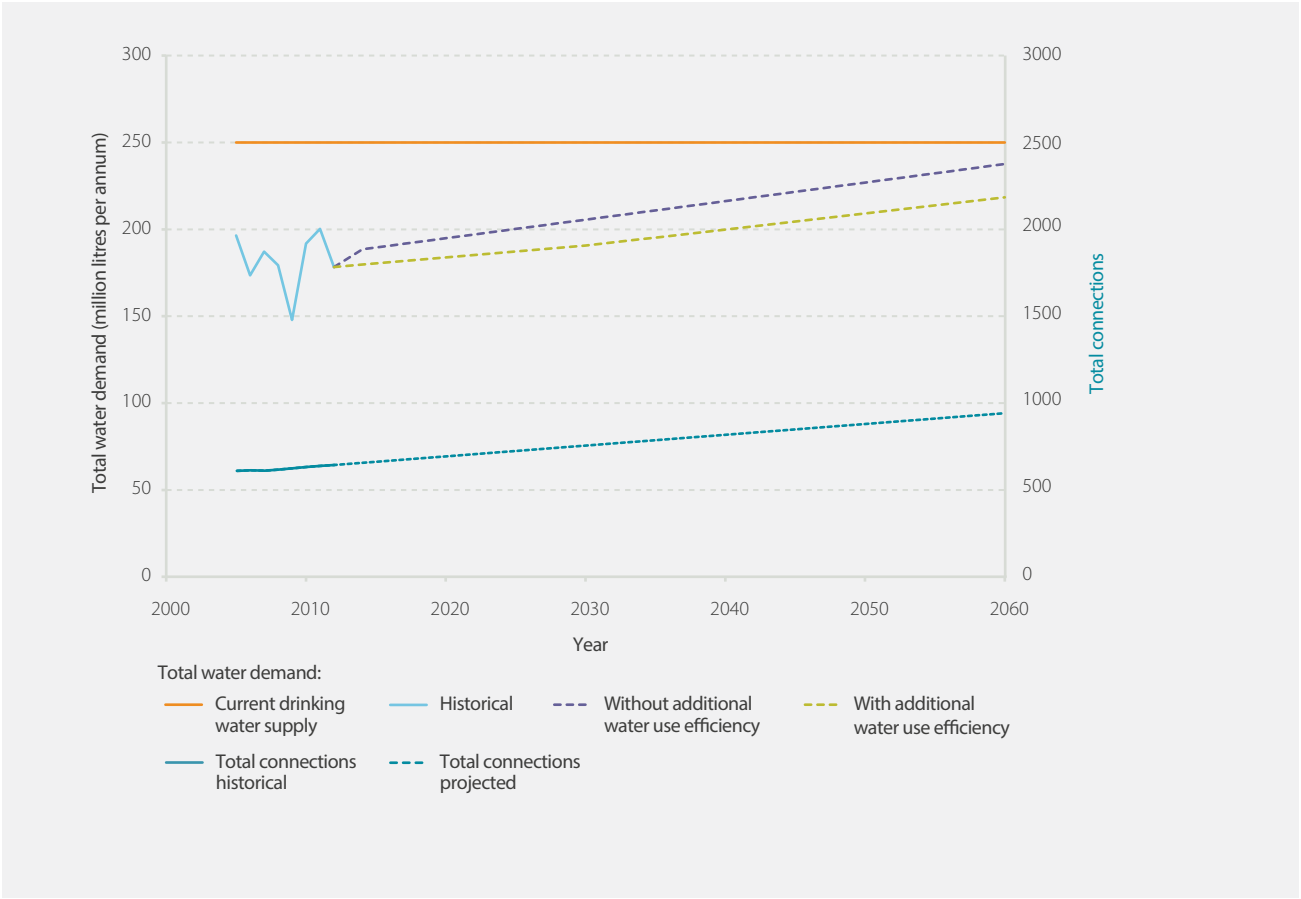
The drinking water demand for Northcliffe and Quinninup is less than 20 million litres per year for each town. Drinking water supplies to these towns are currently carted because of water quality issues with local sources. For small towns, water carting is a solution that provides a safe drinking water supply. If the number of households in the towns rapidly increased, carting would be reviewed.

The high rainfall in this area, combined with the lower temperatures and evapotranspiration rates, mean this area has the lowest per person water use in the South West region.

The water supply from Big Brook Dam and Lefroy Weir are estimated to be sufficient to meet demand until 2060 (see Figure 17 below). Water quality concerns due to activities in the catchment have led to substantial upgrades in water treatment downstream of the weir.

The potential source options for developing new sources in this area are summarised below. There are also long-term options to connect Pemberton to Manjimup, and/or to connect Northcliffe and Quinninup to Pemberton (see 'Connecting local schemes', pages 68–71).

Figure 17 Projected water demand for Pemberton, Quinninup and Northcliffe, with and without water use efficiency measures



Options for Pemberton, Northcliffe and Quinninup

Advanced water treatment at Quinninup Dam

Current situation	Quinninup Dam is no longer used as a drinking water source due to water quality concerns. There is restricted access to the dam but we could provide emergency water from the dam if required. The dam continues to be a proclaimed drinking water source under the Department of Water's catchment protection regulations.
Description of source option	To use Quinninup Dam as a drinking water source in the future, it would require higher levels of treatment and multi-barrier protection, in line with the *Australian Drinking Water Guidelines*. This would mean constructing a new water treatment plant and associated pipelines.
Towns supplied	Quinninup
Potential additional yield per year	Existing dam would be reinstated as a drinking water source
Term/timing	Retained as a contingency option
Benefits	• Dam is already constructed • Water would no longer need to be carted
Issues	• Water quality is of concern and will remain risky because there are septic tanks close to the dam

Quinninup local groundwater

Current situation	There is no existing groundwater scheme in Quinninup.
Current situation	This option requires access to fractured rock aquifer or small-scale localised sedimentary units, which would involve constructing new groundwater bores, a water treatment plant and associated pipelines.
Towns supplied	Quinninup
Potential additional yield per year	Unknown
Term/timing	Long-term option
Benefits	• May provide a local water source
Issues	• Water quality is of concern in fractured rock aquifers • Area is not well-known for groundwater • Water is of unknown quantity and quality so additional investigations are required

Northcliffe Local Dam

Current situation	Northcliffe's small soak has not been used as a water source because of water quality concerns since 2010. Water carting is currently sufficient to meet the town's water demands.
Description of source option	This option involves developing a surface water dam to the north-east of Northcliffe where the Warren State Forest provides enough protection for the drinking water catchment. It would require constructing: • a small dam • 2 storage tanks to ensure water quality protection • 9 kilometres of pipeline and a pipe station, and • an upgraded water treatment plant.
Towns supplied	Northcliffe
Potential additional yield per year	Estimated less than 100 million litres
Term/timing	Long-term option — further investigations needed to determine yields
Benefits	• Community support for surface water sources
Issues	• Rainfall dependent • Streamflow gauging would be required to confirm surface water yields and long-term viability • Environmental approvals from the departments of Environment Regulation, Parks and Wildlife, and Water, would be required before a dam could be constructed

Northcliffe Borefield

Current situation	The Northcliffe town site is located outside of the Perth Groundwater Basin. Therefore, groundwater aquifers are generally superficial, localised and difficult to fully assess without prolonged investigations. There are a number of small, private bores and soaks on local farms. There have not been regional water resource assessment or extensive investigation in the area around Northcliffe, therefore the information on groundwater resources is limited. The area is not within a proclaimed groundwater area so groundwater use is not currently subject to licensing.
Description of source option	This option involves constructing a series of bores to take small volumes of groundwater and treat it locally. It would also require a new water treatment plant to address water quality issues associated with fractured rock aquifers, and associated pipelines.
Towns supplied	Northcliffe
Potential additional yield per year	Unknown as this is not a designated groundwater area
Term/timing	Long-term option — further investigations needed to determine yields
Benefits	• Community support for local water sources
Issues	• Additional work is required to identify a suitable location with sufficient yield • Water quality issues associated with fractured rock and shallow aquifers • Area not well known for groundwater

Pemberton Borefield

Current situation	Pemberton is currently supplied by Big Brook Dam via Lefroy Weir and there is enough water to meet demand until 2060. Water quality concerns due to recreational activities in the area and surrounding land uses have led to substantial upgrades in the water treatment barriers downstream of the weir.
Description of source option	This option is to develop a groundwater scheme from the Yarragadee Aquifer approximately 25 kilometres west of Pemberton. It would require constructing: • a Yarragadee bore • a water treatment plant, and • approximately 25 kilometres of pipeline and associated pump station.
Towns supplied	Pemberton
Potential additional yield per year	300 million litres
Term/timing	Long-term option — not likely to be required before 2060
Benefits	• There are less water quality issues associated with groundwater, compared with surface water options
Issues	• Considerable investigation drilling and hydrogeological studies would be required to determine water availability • Environmental and social considerations associated with a groundwater bore in this area due to the proximity to Lake Jasper, Donnelly River and D'Entrecasteaux National Park

Windy Harbour Micro Seawater Desalination Plant

Current situation	There are no micro seawater desalination plants in the South West. The Southern Seawater Desalination Plant near Binningup does not supply water to the South West.
Description of source option	This option involves constructing a small seawater desalination plant with associated intake and outlet infrastructure east of Windy Harbour. Water could be pumped through a pipeline approximately 25 kilometres north to Northcliffe and then an additional 27 kilometres to Pemberton. A further 25 kilometres of pipeline could extend the scheme to Quinninup.
Towns supplied	Pemberton, Northcliffe and Quinninup
Potential additional yield per year	1 billion litres
Term/timing	Long-term option — not likely to be needed before 2060
Benefits	• Climate independent • The south coast is highly active, which helps with brine disposal
Issues	• Site is remote and relatively underdeveloped • Lack of a suitable power supply — the site would require a suitable three-phase power source to be developed or an alternative technology, such as wave power • Drinking water demand volumes are relatively small

Inland saline reserves

We investigated a source option to supply Quinninup with desalinated water from the Tone River. At this stage, this option is considered unfeasible because, from the limited data available:

- the yield and quality of water from this source is variable
- there are significant challenges with the disposal of the brine, and
- there are other sources closer to the town.

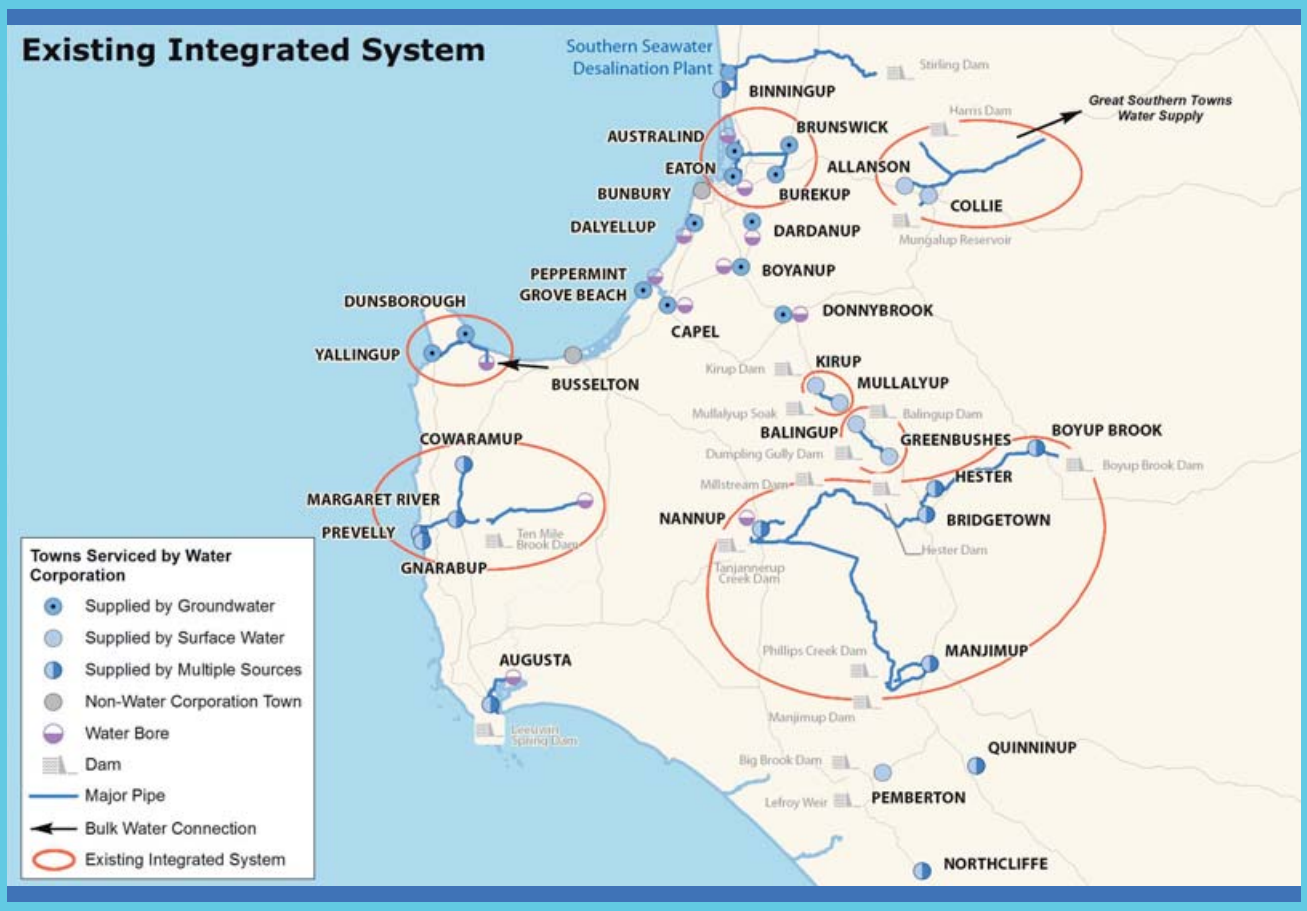
Connecting local schemes

The water supply to towns can be integrated by constructing pipelines to interconnect and pump water between local water sources.

When assessing this as an option for towns, we consider:

- the suitability of existing local water sources to meet future demand and water quality standards
- alternative water sources, and whether these could be developed to meet future needs
- construction and operational costs
- the distance between towns and any challenges for installing pipelines
- the size of pump stations
- the environmental impacts including land clearing and energy use, and
- how susceptible water sources are to dry climatic conditions.

Figure 18 Existing integrated water supply schemes in the South West region



Benefits

By connecting local schemes, we can focus on developing several large water sources, rather than many, smaller local water sources. This may be more cost effective and help manage potential water quality issues through centralised water treatment plants.

A water supply scheme that relies on several water sources at different locations is less vulnerable to operational failures and the drying climate. By incorporating a climate independent drinking water source, such as desalination or groundwater replenishment, there is even greater water supply security.

Costs

While there are benefits to integrating water supplies, constructing pipelines is very expensive. As an example, the 16-kilometre pipeline from Millstream Dam to Greenbushes is estimated to cost $34 million. The high capital cost means that local sources are often developed rather than integrated schemes.

There can also be substantial operational costs with integrated schemes because of the distances the water needs to be pumped between schemes. The energy needed to pump the water has associated carbon emissions and increases the carbon footprint of these options. There are also land clearing considerations that need to be taken into account when constructing pipelines.

The volume of water being moved between water sources determines the cost-effectiveness of integration options. Where there is a large population, high demand for water and scarce local sources, an integrated scheme may be the most cost-effective option. Conversely, where there are long distances and only small volumes of water needed, connecting schemes may be a cost prohibitive option.

Options for the South West

There are already several integrated schemes in the South West:

- Eaton-Australind Regional Water Supply Scheme (incorporating Eaton, Australind, Brunswick Junction, Burekup and Roelands)
- Warren Blackwood Regional Water Supply Scheme (incorporating Bridgetown, Hester, Boyup Brook, Manjimup and Nannup; Greenbushes–Balingup; Kirup–Mullalyup)
- Margaret River Water Supply Scheme (incorporating Margaret River, Cowaramup, Prevelly and Gnarabup)
- Dunsborough/Yallingup Water Supply Scheme, with additional supply from Busselton Water, and
- Collie, which is part of the Great Southern Towns Water Supply Scheme.

We have considered several options to inter-connect towns in the South West and assessed these against a 50-year timeframe, and under various growth, climate and water use efficiency scenarios.

These options are outlined below and we continue to assess the feasibility of integration options as part of our ongoing planning.

Collie and the Great Southern Towns Water Supply Scheme

The Great Southern Towns Water Supply Scheme (GSTWSS) supplies water to 44 towns including Collie and Allanson, east to Lake Grace and south to Tambellup. The annual water demand is about 8 billion litres from more than 15,000 connected properties.

Harris Dam is the main source of water for the GSTWSS and has a capacity of 71 billion litres. The dry years of 2010 and 2012 highlighted the climate vulnerability of the scheme, although the 2013 winter rainfall has restored the dam's levels to meet current water demand.

We have identified a preferred option to supplement the GSTWSS, in the event that Harris Dam was unable to meet the total water demand. The preliminary design and environmental investigations have been done, making this project ready to be commissioned if required in the future.

The recommended option for supplementing Harris Dam is to construct:

- a pump station at Stirling Dam, and
- approximately 10 kilometres of pipeline.

If, over the next 50 years, Stirling and Harris dams cannot meet water demand, an option may be to transfer water from the Southern Seawater Desalination Plant near Binningup via Stirling Dam to Harris Dam.

Status: In planning. Preliminary design and environmental investigations have been completed.

Estimated cost: $64 million (~$4 per 1,000 litres)

Warren-Blackwood Regional Water Supply Scheme

The Warren-Blackwood Regional Water Supply Scheme has been developed progressively over many years. It supplies an estimated population of 10,500 and the current total water demand is less than 1.5 billion litres per year.

The water supply scheme consists of nine surface water sources and a groundwater bore licensed for up to 1.09 billion litres to be taken from the Yarragadee Aquifer.

The scheme currently links the towns of Boyup Brook, Bridgetown, Hester, Manjimup and Nannup. Each of these towns has a local dam and supply can be supplemented by groundwater from a Yarragadee bore near Nannup.

Greenbushes and Balingup are already inter-connected and water is supplied from Greenbushes Dam. A pipeline from Millstream Dam to Greenbushes is under construction at an estimated cost of $34 million and is expected to be completed by 2016.

As demand grows, the capacity of the pipeline from Millstream Dam to Bridgetown will be inadequate, making it necessary to construct a new pipeline. This is expected to happen after 2020.

Additional connections

Mullalyup and Kirup are connected and supplied by local surface water sources, supplemented by water carting. Our long-term planning has identified that, once Greenbushes and Balingup have been connected to Millstream Dam, it would be possible to construct another pipeline and integrate these towns into the larger regional scheme. This option would mean expanding the Greenbushes to Balingup line, and an additional pipeline from Balingup to Mullalyup.

Status: Planning complete. Design and approvals subject to completion of the Greenbushes–Balingup upgrade.

Estimated cost: $22 million (~$14–28 per 1,000 litres)

Pemberton is currently supplied by water sourced from the Lefroy Brook, downstream of Big Brook Dam. There is sufficient water in Big Brook Dam to meet future demand however recreational activities present ongoing water quality challenges, which may make an alternate water source necessary in the long term.

One alternate water source option would be to connect Pemberton to Manjimup Dam. This option would involve 20 kilometres of pipeline and assumes water is treated through the existing Pemberton Water Treatment Plant.

Status: Long-term option — not currently required as local water source is sufficient.

Estimated cost: $24 million (~$8 per 1,000 litres)

Northcliffe and Quinninup are currently supplied by water tankers. The decision was made to cart water due to water quality concerns with the local water sources. Water carting for these small towns is the most cost effective water supply option to ensure safe drinking water.

An integrated system connecting both Northcliffe and Quinninup to Pemberton water supply has been investigated. This option would involve constructing:

- 27 kilometres of pipeline, south from the Burma Road water tank in Pemberton to Northcliffe, and
- 25 kilometres of pipeline, east from the Burma Road water tank to Quinninup.

Status: Long-term option – alternative local water source options are outlined on pages 64–67.

Estimated cost:

- $35 million for Pemberton to Northcliffe (~$70 per 1,000 litres)
- $26 million for Pemberton to Quinninup (~$40 per 1,000 litres)

Other integrated options

We assessed a scenario that integrates a series of climate independent sources, such as micro seawater desalination plants and groundwater replenishment schemes (see Figure 19). This is estimated to cost approximately $1.6 billion and require the construction of:

- micro seawater desalination plants
- pipelines connecting the schemes, and
- pipelines connecting the Southern Seawater Desalination Plant to the Eaton-Australind Water Supply Scheme.

However, for the South West, there are many local water sources (and water efficiency measures) that could be developed before a fully integrated system would be justified. We will continue to carry out further analysis on integrated systems for the South West region as part of our ongoing water supply planning.

Figure 19 Potential integrated water supply schemes for the South West region 2060

Where to from here?

The potential source options presented in this final report are the result of detailed analysis and sustainability assessments to address the needs of future drinking water demand in a drying climate.

Key innovations and challenges

While possible to anticipate changes in the climate and drinking water demand over the next 50 years, there are other factors that are likely to significantly influence the plan and how it is ultimately implemented. These include improvements in technologies and changes in energy costs. There will be innovations to help provide solutions to water supply challenges, some of which are outlined below.

Waterless technologies

There have been developments to improve the water efficiency of plumbing products and appliances, which has been facilitated by a national approach to labelling through the introduction of the Water Efficiency Labelling and Standards (WELS) scheme in 2005. There are still gains that can be made such as the development of waterless appliances including washing machines, showers and urinals.

Future energy sources

Large amounts of energy are needed to move water over long distances. As it becomes harder to find local water sources, or as higher levels of treatment are applied to water and wastewater, the energy needs are expected to increase. Access to cost effective energy sources will be a significant factor for all water utilities.

The South West has swells generated from the ocean which may be suited to technologies such as wave energy. This would be similar to the Garden Island project where renewable electricity is generated from buoys beneath the ocean surface being placed just off Garden Island. When waves move the buoys, it creates hydraulic pressure which is delivered to the a plant onshore to be converted to power. These technologies are also being trialled to produce desalinated water.

The South West region also has access to geothermal energy in the southern Perth Basin with initial research indicating the Whicher Range may be a suitable area. Technology improvements or the need to develop low carbon emission sources of energy may reduce the cost of these alternative energy supplies.

Resource recovery from nitrogen and phosphorous

Water Corporation has a goal of recycling 30 per cent of treated wastewater across the state by 2030. In the future, water recycling may focus beyond the water component and recognise wastewater as a key source for natural sources such as nitrogen and phosphorous. This is particularly relevant for phosphorous, which is a limited resource and critical for food production.

Safe and economic disposal of brines

Desalination is becoming more cost effective with advances in membrane technology, energy efficiency and energy recovery. However, because the process produces a saline brine that needs to be discarded, in Western Australia large plants are located on the coast.

If advances in brine disposal were developed, desalination plants could be located in non-coastal areas. This would reduce the distances that the desalinated water would need to be pumped, making inland schemes more economically viable.

The research in this area is moving beyond brine disposal to recovery of valuable salts from the brines.

Timeframe for review

Dependent on growth rates in the South West Region, it is anticipated this document will be reviewed within 10 years.

South West Water Forever implementation plan

With the finalisation of the *Water Forever: South West* report, the Water Corporation will turn its attention to implementing identified actions. These are summarised in table below.

Ongoing discussuions

The Water Corporation would like to thank the community members and organisations who took the time to contribute to this report.

This report is not the end of discussion; it is a platform from which to build on. It provides a framework of future water supplies that are sustainable, cost effective and have the least impact on the environment. There will be ongoing community dialogue as water efficiency strategies are implemented, and ongoing investigations and assessments are undertaken on new water sources and recycling options.

Whichever options are pursued, they will mean working in partnership with all sectors of the community, including households, business, industry and agriculture.

Identified Action	Summary	Estimated Timeframe
South West Water Efficiency Program	Reduce water use by targeted application of established programs and by continuing to implement technologies such as data logging and leak detection.	25% reduction on 2008 water usage by 2030
Recycling Opportunities	Continue to look for recycling wastewater opportunities, such as Groundwater Replenishment and Managed Aquifer Recharge, especially for the Greater Bunbury and Busselton area.	Long term option – investigations may commence between 8 and 10 years prior to a scheme being required
Public Open Space	Work with the DoW and other water users to identify opportunities to recycle non-potable water for Public Open Space, especially where it offsets groundwater that instead can be used for public water supply.	Ongoing – member of the DoW South West non-potable water needs technical advisory group
Bulk water agreements between water utilities	Continue with our bulkwater agreement with Busselton Water and establish an agreement with Aqwest.	2015 for Aqwest and ongoing for Busselton Water
New water source opportunities – groundwater, surface water and micro seawater desalination plants	Review the source options identified for a town's water supply when growth rates trigger an additional source.	As required – usually undertaken 5 to 10 years before the source is estimated to be needed.
Support DoW resource assessment work program, including seawater intrusion investigations for the Bunbury groundwater area and development of regional and sub-regional groundwater models	DoW lead investigations to improve definition of groundwater availability.	2015-17

Glossary

Alternative water supplies – include sources of water used for garden watering, toilet flushing and clothes washing. These are often termed 'fit for purpose' and utilise water of varying quality as it is not required to be of drinking water standard. Alternative water supplies are usually managed at household or community level.

Aqwest — the trading name of the Bunbury Water Corporation which is the water utility responsible for supplying water to Bunbury residents.

Bushfires, water for — town water supply systems are not designed to meet fire-fighting requirements however the Water Corporation provides access for fire and emergency services through fire hydrants and standpipes, and works with local fire brigades to arrange direct access to water sources during emergencies. For more information, visit watercorporation.com.au.

Busselton Water — the water utility responsible for supplying water to Busselton residents.

Catchment management — includes a range of forestry practices to return the forest to a more natural state that will use less water and therefore improve streamflow and runoff. The treatments can include selectively removing trees, controlling re-growth, replacing exotic trees with native species, and prescribed burning.

Dams — Local rivers or streams impounded for long-term water storage.

Department of Water (DoW) — a department of the Government of Western Australia that is responsible for managing the availability and quality of water, sustainably (see water.wa.gov.au).

Department of Parks and Wildlife (DPAW) — The state Department of Parks and Wildlife protects and conserves Western Australia's natural environment on behalf of the people.

Direct potable reuse — treated wastewater is further treated to drinking water standards and supplied directly to a drinking water supply system.

Drinking water — water that meets the Australian Drinking Water Standards.

Dual reticulation — see 'purple pipe system'.

Fit for purpose — term used to describe recycled water that is for a specific purpose, for example irrigation.

Gigalitre — one billion litres, or one thousand million litres.

Greywater — household wastewater that comes from the bath, shower, washing machine, dishwasher and sinks.

Greywater system — a system installed to take household wastewater, excluding from toilets, and reuse it for non-drinking water uses, typically garden irrigation.

Groundwater — water sourced from underground aquifers, made up from (mostly) rain which trickles down through the rocks and soils and into aquifers.

Groundwater replenishment — the process where treated wastewater is further treated to drinking water standards and recharged into groundwater supplies. The water can then be stored and taken out some time later for further treatment and supply to a drinking water system.

Indirect potable reuse — treated wastewater is further treated to drinking water standards and returned to the natural water cycle/system before being supplied to a drinking water supply system

Infiltration — the process by which water on the ground surface moves downward to the water table.

Infill sewerage — a system of buried pipes that takes wastewater away from residential properties for safe and healthy treatment and disposal.

Integrated Water Supply System (IWSS) — the system that delivers water each year to over 2 million people in Perth, the Goldfields and Agricultural region and some parts of the South West.

Leak detection — monitoring water usage to identify leaks. It can be done at a household level by monitoring the water meter overnight. On a larger scale, water utilities can use data logging to detect leaks in customer water systems, and techniques such as flow meter testing to find leaks in pipelines.

License — allows the holder to take water from an underground source.

Managed aquifer recharge — water (including wastewater, stormwater or rainwater) is purposefully re-directed into an aquifer.

Managed aquifer recharge for salt water intrusion — highly treated wastewater is recharged into aquifers along the coast to create a 'water barrier' to prevent seawater from seeping into the less saline groundwater.

Managed aquifer recharge for industry or agriculture — highly treated wastewater is recharged into aquifers allowing it to be taken out later by industry and/or agriculture.

Non-revenue water — Lost or unaccounted water in a supply system, which includes water used for firefighting, lost through leaks or flushing pipes.

Pipe-head dam — a diversion dam that takes streamflow from the catchment to another dam for storage.

Potable water — a term used for water that meets drinking water standards.

Public open space — a generic term used to describe parks, golf courses, playing fields and other recreation areas, particularly in relation to water recycling.

Public water reserve —the amount of groundwater set aside for the South West's future drinking water supplies up to 2034 in the *Department of Water's South West Areas Groundwater Allocation Plan (2009)*. Currently, there is approximately 18.7 billion litres per year in the public water reserves, which is about nine per cent of the water available in the plan. To access this reserved water, a public water utility needs to apply for a licence from the Department of Water.

Public Water Supply — A public drinking water suppy system authorised under the *Water Services Act 2012*.

Purple pipe system — non-drinking water is provided to new developments through an additional pipe system used for non-drinking water uses such as toilet flushing or landscape and public open space irrigation. Also known as a dual reticulation or third pipe system.

Rainwater tanks — tanks used domestically to collect rainwater, used either as the primary or supplementary source for household water supply.

Ramsar Convention — the Convention on Wetlands of International Importance, signed in Ramsar, Iran on 2 February 1971, which aims to stop the loss of wetlands and conserve those that remain.

Retrofits — existing plumbing products, such as shower heads, single-flush toilets and irrigation controllers, which do not meet Water Efficiency Labelling and Standards (WELS) are upgraded with products that are WELS rated.

Salt water intrusion — the movement of denser, salty water into fresher water which is less dense. It typically occurs along coastlines and can occur in surface and groundwater systems.

Seawater desalination — seawater is treated to remove salt and other minerals making it suitable for drinking.

Smart metering — advanced metering units are installed to enable more frequent and remote monitoring of water use and early detection of leaks at properties.

SuperTown — a town identified in the State Government's Regional Centres Development Plan that receives Royalties for Regions funding so that they can plan and implement projects and services to cater for population expansion and economic growth.

Third pipe system — see 'purple pipe system'.

Urban density — the number of houses developed in a land area. Increased density, including the development of multi-residential dwellings, tend to result in smaller living areas particularly gardens and reduced water consumption.

Water carting — drinking water is transported to small towns by truck when local sources are unavailable or inadequate.

Water restrictions — sprinkler bans to limit the use of automated irrigation in spring, summer and autumn.

Water trading — the buying and selling of tradeable water rights between licensed water users, allowing it to be redistributed. In Western Australia, water trading is regulated by the Department of Water.

WELS Scheme — the Water Efficiency Labelling and Standard Scheme requires certain products to be registered and labelled with a star rating to indicate their level of efficiency. It applies to showerheads, tap equipment, toilets and urinals, washing machines and dishwashers. A minimum water efficiency standard applies to toilets and washing machines.

References and further reading

Australian Academy of Technological Sciences and Engineering, 2013, *Drinking water through recycling — the benefits and costs of supplying direct to the distribution system.*

Australian Bureau of Statistics (2013), *Environmental Issues: Water use and Conservation*, March 2013, category number 4602.0.55.003, Australian Bureau of Statistics, Australia.

CSIRO (2009), *Groundwater yields in south western Western Australia*. A report to the Australian Government from the CSIRO South-West Western Australia Sustainable Yields Project. CSIRO Water for a Healthy Country Flagship, Australia.

CSIRO (2009), *Surface water yields in south west Western Australia*. A report to the Australian Government from the CSIRO South-West Western Australia Sustainable Yields Project. CSIRO Water for a Healthy Country Flagship, Australia.

CSIRO (2009), *Water yields and demands in south-west Western Australia*. Summary of a report to the Australian Government from the CSIRO South-West Western Australia Sustainable Yields Project. CSIRO Water for a Healthy Country Flagship, Australia.

Department of Planning (2013), *Greater Bunbury Strategy 2013 Final Report*, Department of Planning, Perth, Western Australia.

Department of Planning (2013), *Greater Bunbury Structure Plan 2013 Final Report*, Department of Planning, Perth, Western Australia.

Department of Water (2009), *Blackwood Groundwater area — sub area reference sheets*, plan companion for the South West Groundwater Areas Allocation Plan, May 2009, Department of Water Perth, Western Australia.

Department of Water (2009), *South West Groundwater Areas Allocation Plan*, Water Resource Allocation and Planning Series, Report No. 21, May 2009, Department of Water Perth, Western Australia.

Department of Water (2010), *South West Regional Water Plan: 2010–2030*, Department of Water Perth, Western Australia.

Department of Water (2010), *South West Regional Water Plan: 2010–2030:* Supporting detail, Department of Water Perth, Western Australia

Department of Water (2013), *South West Groundwater Areas Allocation Plan:* Evaluation statement 2009–2012, August 2013, Department of Water Perth, Western Australia.

Environment Protection and Heritage council, Natural Resource Management Ministerial council (NRMMC) (2008), *Australian Guidelines Paper 22 for water recycling: managing health and environmental risks (phase 2) — Augmentation of drinking water supplies*, National Resource Management Ministerial Council, Commonwealth of Australia, Canberra, Australia.

Environment Protection and Heritage council, NRMMC (2009), *Australian Guidelines Paper 24 for water recycling: managing health and environmental risks (phase 2) — Managed aquifer recharge*, National Resource Management Ministerial Council, Commonwealth of Australia, Canberra, Australia.

Indian Ocean Climate Initiative (2012), *Western Australia's Weather and Climate: A Synthesis of Indian Ocean Climate Initiative Stage 3 Research*. CSIRO and Bureau of Meteorology, Australia.

NHMRC, NRMMC (2011), *Australian Drinking Water Guidelines Paper 6 National Water Quality Management Strategy*. National Health and Medical Research Council, National Resource Management Ministerial Council, Commonwealth of Australia, Canberra, Australia.

South West Development Commission (2013), *South West Regional Blueprint Draft*, February 2013, South West Development Commission Regional Development Australia.

Tourism Western Australia (2013) *Overnight Visitor Fact Sheets*, YE 2007–2013.

Western Australian Planning Commission and Department of Planning (2009) *South-West Framework*.

Western Australian Planning Commission and Department of Planning (2012), *Western Australia Tomorrow, Population Report No. 7 2006 to 2026*.

The following information and documents are available on the Water Corporation's website at watercorporation.com.au/waterforeversw

Water Forever: South West Sustainability Assessment Report
Water Forever: South West Community Engagement Report

There are also fact sheets on the various water supply schemes for the South West region.

The following information and documents are available on the Water Corporation's website at watercorporation.com.au

Waterwise Programs
Water Forever Perth plan
Water Forever: Lower Great Southern plan

There is also a wide range of information on the Water Corporation website about how to save water, water recycling and solutions to Perth and regional water supply.

Contact details

Tel: (08) 9725 5148 or (08) 9420 3656
Email: sw.waterforever@watercorporation.com.au
watercorporation.com.au/waterforeversw

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