



# Upper Collie

## water allocation plan

### Evaluation statement 2009–2017

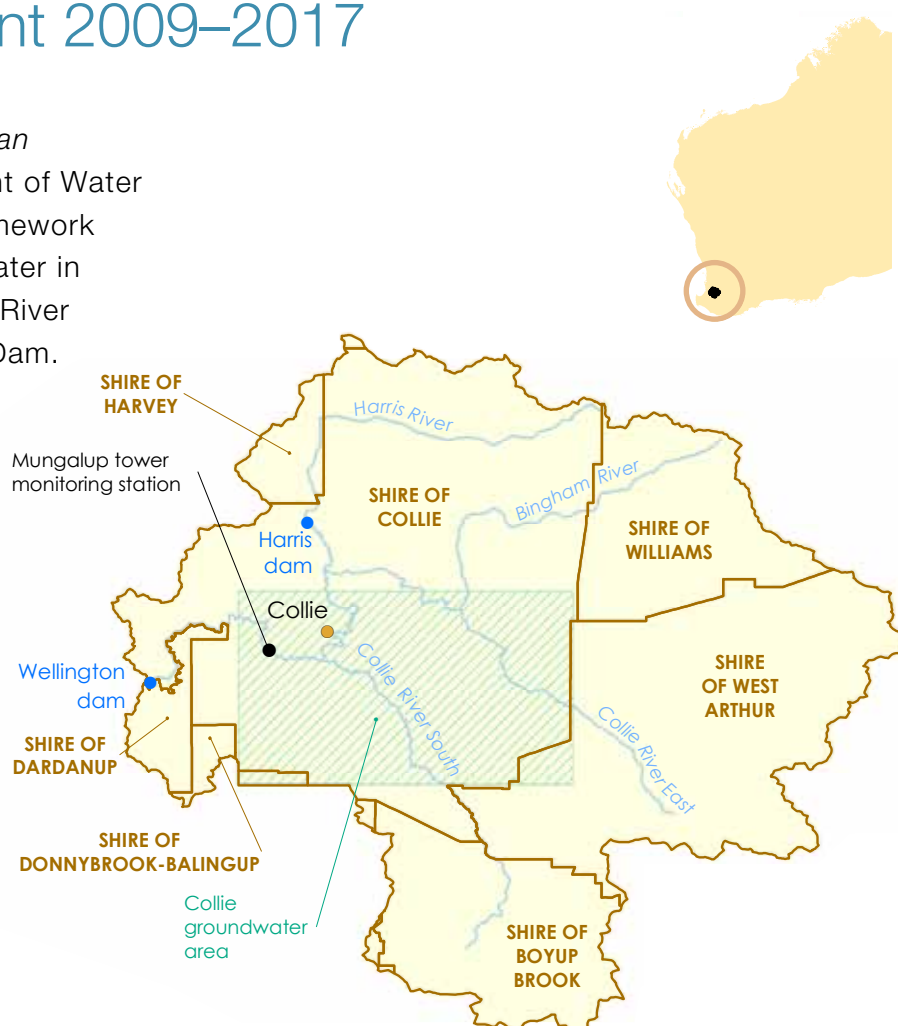
The *Upper Collie water allocation plan* (Upper Collie plan) is the Department of Water and Environmental Regulation's framework for allocating ground and surface water in the Collie Coal Basin and the Collie River catchment upstream of Wellington Dam.

This is the first evaluation statement for the Upper Collie plan. It summarises how water resources were managed since the plan was published in 2009 and our performance against the plan's objectives.

A key feature of the Upper Collie plan was balancing the groundwater needs of coal mining and power generation, the environment and other local industries. The plan also set allocation limits for the upper Collie River and its tributaries to help manage salinity and improve the river environment.

Managing groundwater in the Collie Coal Basin, and salinity in the upper Collie River, is challenging in the context of climate change, changing mining activities and the prospect of rising salinity in the catchment.

This evaluation statement highlights our improved understanding of the complex



#### Upper Collie plan area

surface and groundwater resources in the area. We are working with licensees and other stakeholders to resolve the significant water challenges, adapting water management using scientific evidence and investigating new water opportunities.

# Water resources in the Upper Collie plan area

The Upper Collie plan area covers around 2800 km<sup>2</sup> and includes the catchments of five rivers and the Collie groundwater area.

The Collie River and its tributaries flow into Wellington Dam, the largest dam in the southwest of Western Australia. Harvey Water uses water released from the dam to supply the Collie River Irrigation District and to support environmental values in the lower Collie River. The dam release arrangements are set out in the *Lower Collie surface water allocation plan, 2015*.

The Water Corporation uses Harris Dam, located on the Harris River, for the Great Southern Towns Water Supply Scheme.

The Collie groundwater area covers the Collie Coal Basin. Here licences to take groundwater are aligned with State Agreements to enable the safe and efficient mining of coal below the watertable. This groundwater is used to generate electricity supplied to Perth and the South West.

The *Collie Coal (Griffin) Agreement Act 1979* and *Collie Coal (Western Collieries) Agreement Act 1979* ratify agreements between the Government of Western Australia and the mining companies with respect to mining, development and rehabilitation of certain coal reserves.

The intent of the State Agreements is to safeguard coal requirements for electricity production and industry, and enable the expansion of coal mining and production for the coal mining company. Also, these State Agreements prioritise Western Power's access to available water, including dewater.



Harris Dam

# Improving how we manage water

The main achievements between 2009 and 2017 were:

- Reducing over-allocation by 25 GL/year through water licensing, compliance measures and improved water use efficiency by licensees.
- Collaborating with Griffin Coal to update the local groundwater water model and improve understanding and management of the groundwater system.
- Working with stakeholders and across government to identify alternative contingency water supplies for industry to reduce reliance on mine dewater.
- Continuing to engage across government on mine closure and residual impacts to water resources associated with coal mining in the basin.
- Collaborating with Premier Coal on the Lake Kepwari flow-through trial to provide alternative closure options for suitable open cut mine voids. Results from the trial show water quality improvements within the lake with minimal changes to downstream flows.
- Launching of the \$5.7 million Myalup-Wellington Water for Food project in February 2015.

Objective	How the objective was met 2009–2017
1. Increase accountability for water use and its associated impacts	<ul style="list-style-type: none"> <li>• Developed the <i>Collie Coal Basin Water Use Balance</i> tool to track the take, use, disposal and supply of water between mining and power generation companies. This improves water accountability, transparency and provides opportunities to optimise water use.</li> </ul>
2. Limit abstraction of water up to or equal to the allocation limit for a resource (other than mine dewatering)	<ul style="list-style-type: none"> <li>• Kept licensed entitlements at or below the allocation limit for all seven surface water subareas.</li> <li>• Other than for dewatering, licensed use remains below the allocation limit in the Premier subarea and average licensed use has remained below the allocation limit in the Cardiff subarea since 2007 – 08. This was achieved by ensuring alternate water sources, such as dewater, are used in preference to additional groundwater abstraction.</li> <li>• Regularly undertook compliance activities for significant water users to ensure licensees meet licence conditions.</li> </ul>

Objective	How the objective was met 2009–2017 contd.
3. Recover over-allocated water resources to sustainable levels	<ul style="list-style-type: none"> <li>• Proactively reduced entitlements to reflect operational requirements.</li> <li>• Continued to proactively support and advise licensees on alternative water source options.</li> </ul>
4. Protect existing ecological, social and cultural values	<ul style="list-style-type: none"> <li>• Continued to adaptively manage environmental releases from the Wellington Dam and Harris Dam that are required under license to maintain downstream values.</li> <li>• Commissioned the <i>Collie Basin groundwater assessment – State of the Basin</i> (GHD 2010), funded by the Australian Government's <i>Water for the Future</i> initiative to guide groundwater management.</li> <li>• Collaborated with Premier Coal on the Lake Kepwari flow-through trial to enhance the quality and ecological value of water within the void.</li> <li>• Continued to undertake river health assessments on the Collie River and its tributaries.</li> <li>• Worked across government and within the Collie Coal Mines Environmental Committee (CCMEC) to manage current water use and guide future use and risks in the context of mine closure planning. The CCMEC, chaired by the Department of Jobs, Tourism, Science and Innovation, is comprised of the Department of Water and Environmental Regulation, the Department of Biodiversity, Conservation and Attractions, and the Department of Mines, Industry Regulation and Safety.</li> </ul>
5. Protect the security of supply for water users	<ul style="list-style-type: none"> <li>• Continued to work with major water users; Synergy, Griffin Coal, Premier Coal, Bluewaters Power and the Department of Jobs, Tourism, Science and Innovation, to ensure water use is as sustainable as possible despite the challenges in the area.</li> </ul>
6. Ensure that water is used in the most efficient way	<ul style="list-style-type: none"> <li>• Collaborated with mining and power generation companies to optimise the use of fit for purpose water to reduce groundwater demand and abstraction.</li> </ul>
7. Achieve the highest value use for water resources	<ul style="list-style-type: none"> <li>• Commenced the Myalup-Wellington Water for Food project to explore opportunities in optimising the use of Wellington Dam in support of horticultural development in the Myalup Irrigation Agricultural Precinct and Collie River Irrigation District.</li> <li>• Provided recommendations to transition the use of surplus dewater from river disposal to power generation.</li> </ul>
8. Minimise water quality impacts of abstraction and use, and where possible, increase the quality of the water resources	<ul style="list-style-type: none"> <li>• Introduced a cumulative impact assessment process to minimise water quality impacts across the region when: <ul style="list-style-type: none"> <li>- assessing new proposals.</li> <li>- reviewing management of existing operations.</li> <li>- confirming our preference for a basin wide mine closure plan for the Premier subarea.</li> </ul> </li> <li>• Continued to engage across government to highlight the long-term legacy risks to ground and surface water resources associated with coal mining and mine closure.</li> <li>• Improved our understanding and guided management of groundwater and surface water through several projects: <ul style="list-style-type: none"> <li>- Updated Upper Collie catchment surface water runoff model (LUCICAT) and Wellington Dam water balance model (TwoRes).</li> <li>- Edith Cowan University's series <i>Mine Voids Management Strategy I-V</i> (2009 and 2010).</li> <li>- <i>Collie Basin Groundwater Modelling</i> (SKM 2010).</li> </ul> </li> </ul>

# Status of water resources

Over the last four decades, rainfall in the state’s southwest has declined causing decreased surface water flow in rivers and less recharge to groundwater systems. Climate change has become a critical factor in planning for both surface water and groundwater resources.

Since the release of the Upper Collie plan in 2009, annual average rainfall at Collie (Bureau of Meteorology rainfall station 9628) has declined four per cent from the previous 30 year (1975 to 2008) average (Figure 1). Using the Department of Water and Environmental Regulation climate guidelines (Department of Water 2015), we project a possible further three per cent rainfall decline by 2030 compared to the 2009 to 2017 average.

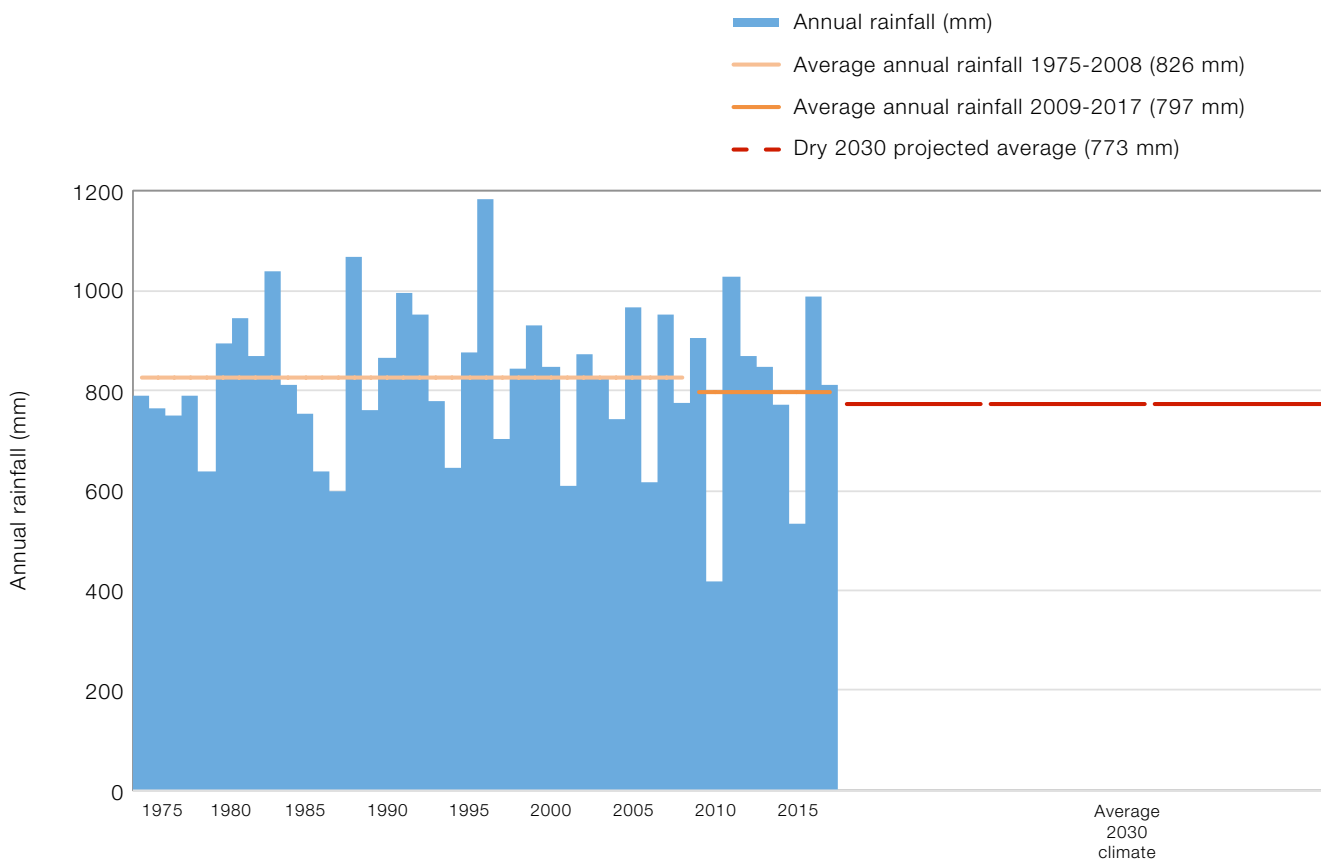


Figure 1 | Annual rainfall at the Collie rainfall site (Bureau of Meteorology rainfall station 9628)



Water levels in the Collie River

## Surface water

The majority of surface water subareas in the Upper Collie plan area experienced changes in stream flow much greater than the changes in rainfall with flows over the past 10 years substantially less than the long-term average. Climate modelling shows that declining rainfall, and subsequently lower stream flow, will continue into the future.

The average annual stream flow from 2009 to 2017 was 56.5 GL/year at the Mungalup Tower monitoring location on the Collie River (Figure 2). This is a 41 per cent reduction compared to the 1975 to 2008 average of 95.7 GL/year.

Since the release of the Upper Collie plan, there have also been two exceptionally low flow years, 2010 and 2015. At Mungalup Tower, flows of 7 GL and 15 GL were recorded in these years respectively, and Collie River South branch did not contribute any flow into the Collie River for either year (Figure 3). Consequently, some river pools dried out on the Collie River South branch.

Mine dewater disposal into the river has contributed an average of 9.9 GL/year

to stream flow since 2010. This greatly masked the effects of reduced stream flow in the Collie River, particularly through the Collie town site.

Salinity has continued to increase at Mungalup Tower since 2009, with the highest recorded average annual salinity concentrations coinciding with the low flow years (Figure 4). Compared to the 1975 to 2008 period, average annual salinity from 2009 to 2017 has increased by 20 per cent, to 1549 mg/L.

Dry land salinity, caused by historic land clearing in the southern and eastern portions of the catchment, and reductions in stream flow, especially in tributaries like the Bingham River that contribute fresh water to the Collie River, are the main causes of increased salinity. Salinity levels are highest in the east branch of the Collie River, reaching 16 000 mg/L during the first flush winter flows. The east branch contributes around 70 per cent of the salt in Wellington Dam. See the Water for Food section of this statement for more information.



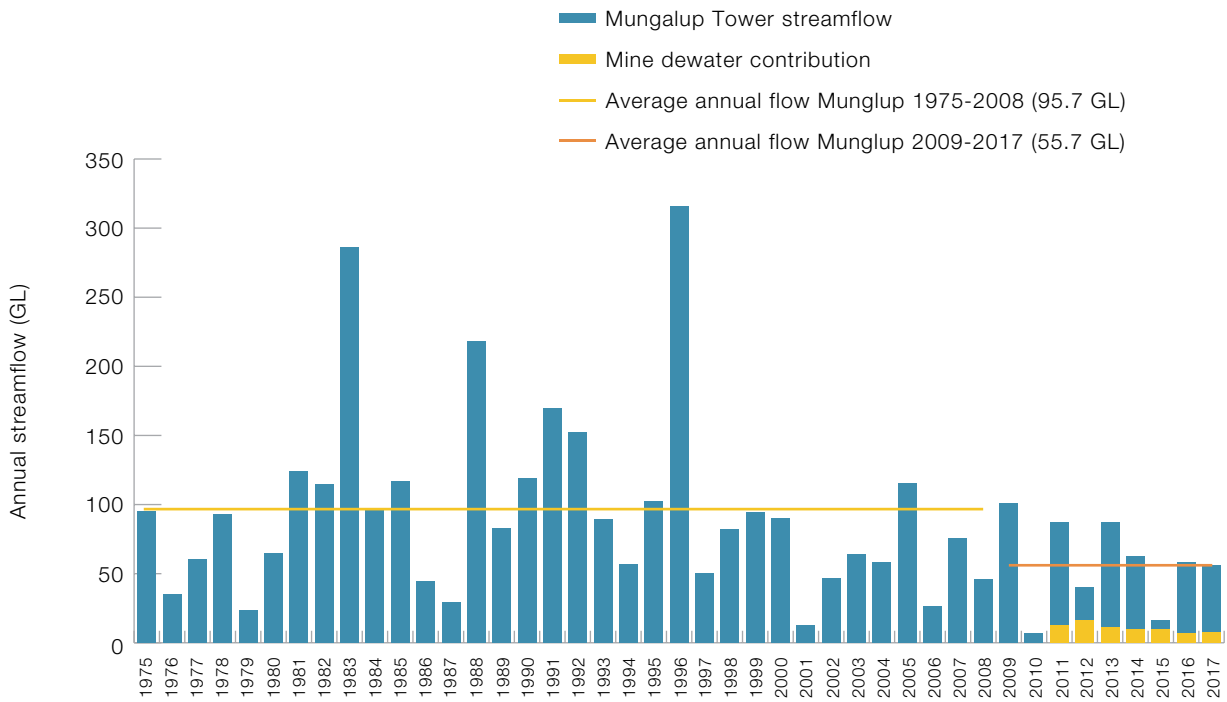


Figure 2 | Annual stream flow at Mungalup Tower on the Collie River

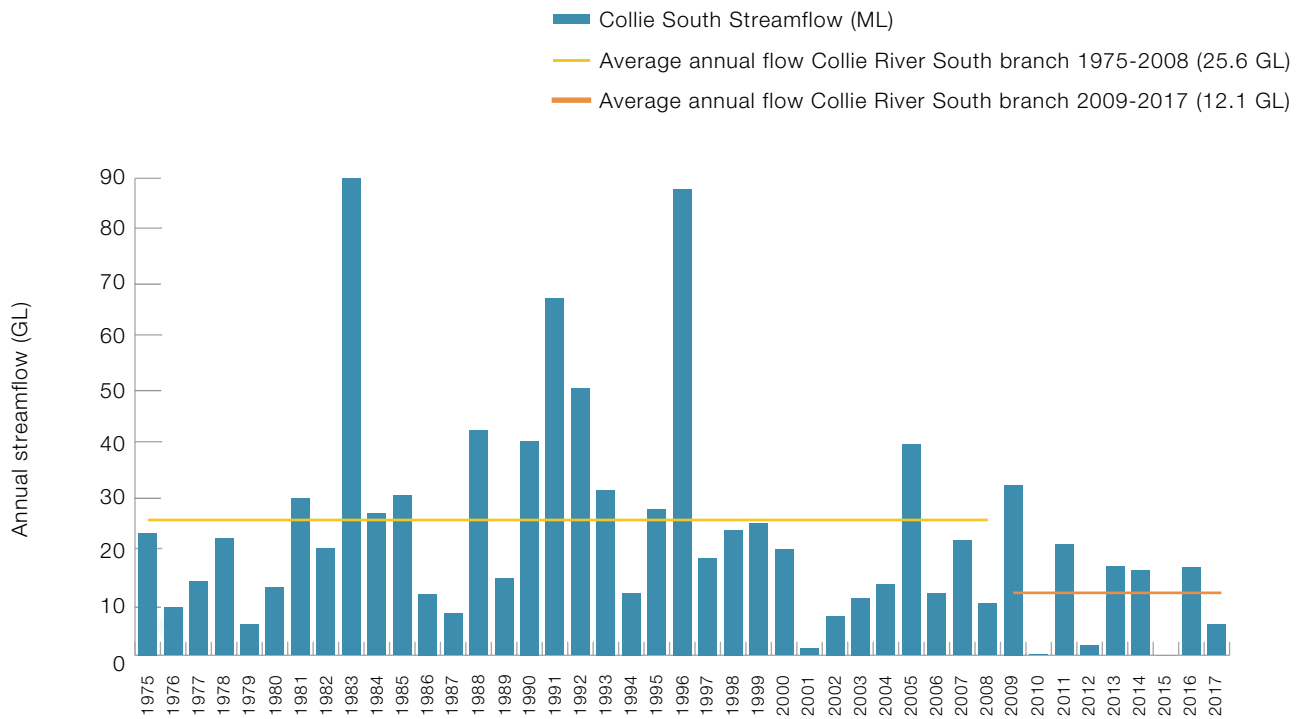


Figure 3 | Annual stream flow at Collie South on the Collie River South branch

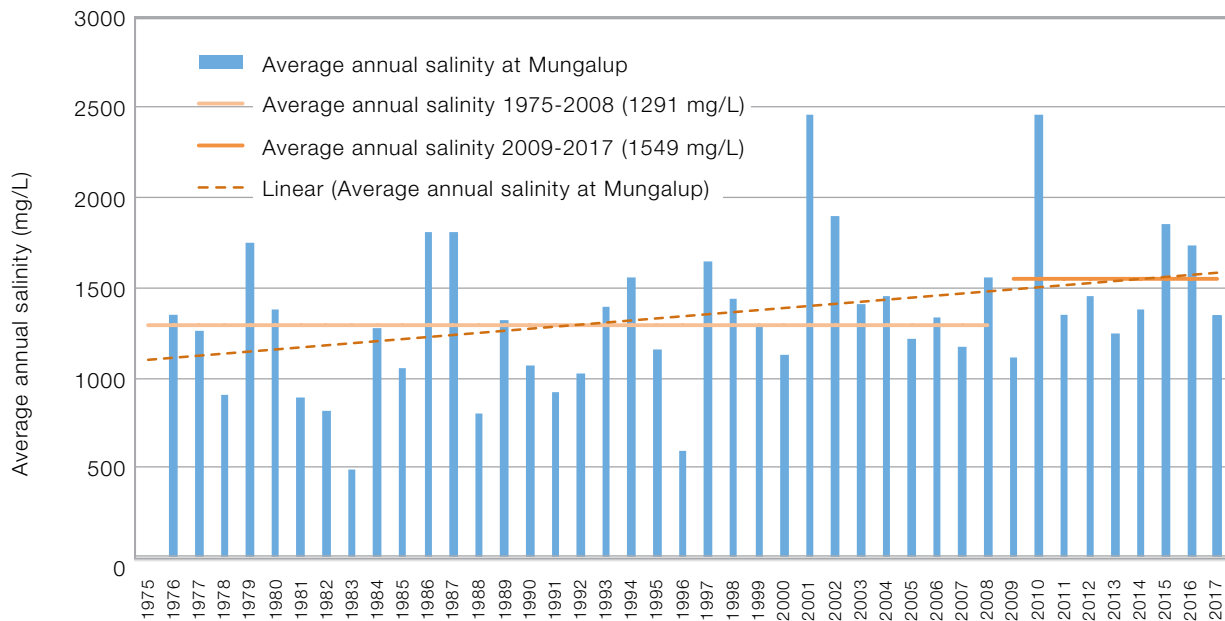


Figure 4 | Average annual salinity at Mungalup Tower

## Surface water and groundwater interaction

Duderling and Buckingham Bridge pools on the Collie River East branch were historically groundwater-dependent. The pools and Chicken Creek, a tributary of the east branch, have become disconnected from groundwater in the Premier subarea as a result of nearby dewatering. This resulted in saline surface water intruding into groundwater systems (saltwater intrusion). The pools are supplemented during summer months to maintain social and environmental values.

## River supplementation

In 1999, following recommendations from the Collie Water Advisory Group (1996), the department coordinated groundwater supplementation of the east and south branches of the Collie River. The aim was to maintain the ecological and recreational value of pools on these systems.

The department supports supplementation of Duderling and Buckingham Bridge pools (Collie River East branch) to offset groundwater drawdown from mining. However, supplementation was stopped in the south branch in 2007 following issues with the quality of the source water (acidity and elevated concentrations of dissolved metals). Our review of studies conducted by Synergy concluded that, against the significant costs associated with providing another source of water, there would be little to no ecological, cultural or social benefits from recommencing supplementation of the south branch pools.

While the Upper Collie plan supported supplementation of the Cardiff Town Pool on the south branch, based on the more recent assessment the department has revised this position. Periods of low flow and low pool levels in the south branch are primarily a natural response to climate change.



# Groundwater

Abstraction is licensed in the Premier and Cardiff subareas of the Collie groundwater area (Figure 5), while no significant aquifers occur in the Collie subarea. Using licensee monitoring data and the improved groundwater model, we have increased our understanding of groundwater in these areas, along with the emerging risks associated with mining and abstraction.

Within the Premier subarea, recharge is estimated at 7.8 GL/year while annual abstraction for dewatering ranges between 19.3 GL/year and 27.3 GL/year. This supports dewatering as the main driver of groundwater level declines.

Groundwater quality in the Premier subarea ranged from slightly acidic to acidic, with a reducing pH trend reflecting both natural processes, and processes resulting from

coal mining activity, such as acid and metalliferous drainage. Groundwater salinity is highly variable, ranging from fresh to slightly brackish. This reflects a range of influences including the local hydrogeology and areas directly affected by salt water intrusion on the Collie River East and Chicken Creek branches.

Despite ceasing dewatering in the Cardiff subarea, groundwater level recovery was negligible. This can be attributed to continued local abstraction, propagation of impacts from dewatering in the Premier subarea and climate-induced declines in recharge.

Groundwater in the Cardiff subarea is slightly acidic, with increased acidity in areas of higher abstraction or where mining activities occurred historically. Groundwater salinity is fresh to marginal, tending to slightly brackish in other areas of higher abstraction.

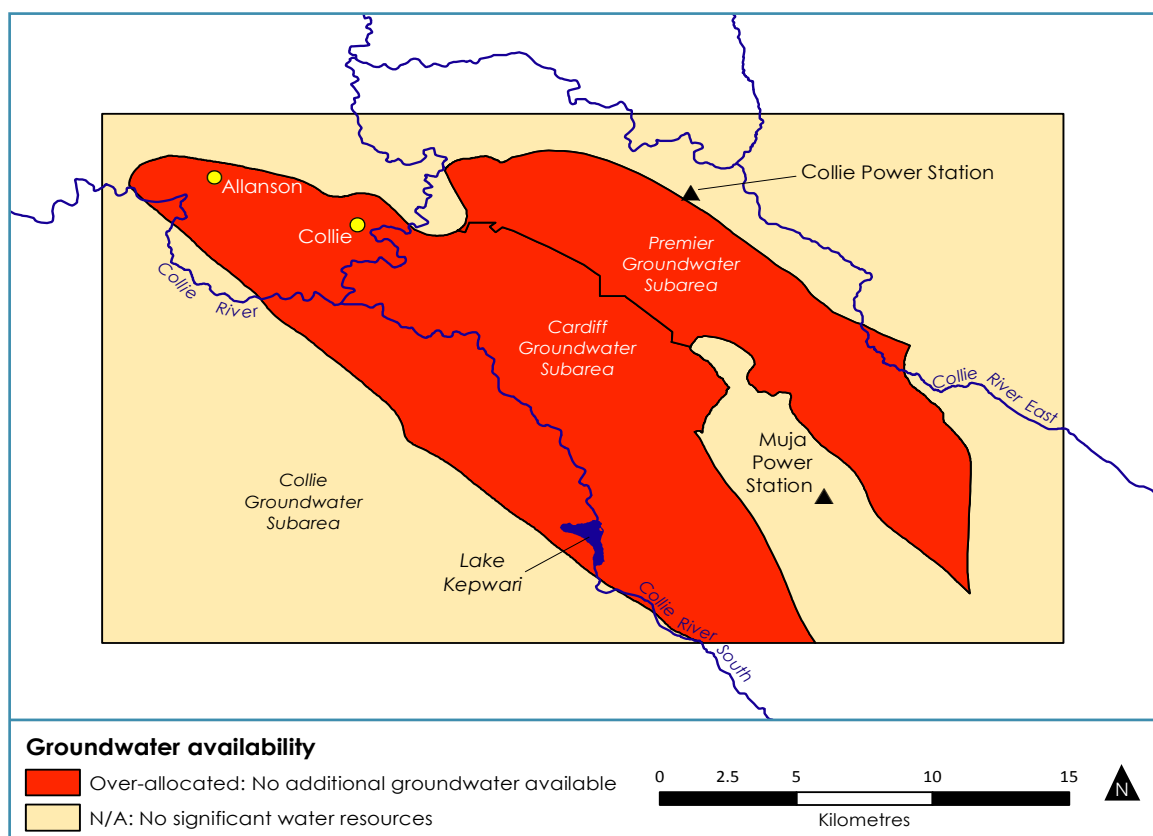


Figure 5 | Groundwater subareas, key locations and availability

## Groundwater recovery and new information

The Upper Collie plan aimed for the recovery of groundwater levels in the Cardiff subarea as mining slowed and major dewatering ceased. Our most up to date groundwater monitoring data review and use of the groundwater model, suggests that water levels are not recovering at the rate expected and will take significantly longer than anticipated.

The department will continue to work with stakeholders to review how the aquifers are responding to changing mining activities and climate change. We aim to minimise risks to water quality in the water resources and locally important environmental features including the Collie River. Ongoing groundwater level and quality monitoring continues to inform and improve our understanding of this risk.

Lake Stockton is managed by the Department of Biodiversity, Conservation and Attractions. The lake is likely to experience lower water levels in the future as the cumulative effects of mine dewatering lead to groundwater declines. Mining operations also reduce the catchment area for surface flows into the lake. This may also increase the acidity of the lake and reduce water quality, potentially affecting its recreational use and visual amenity.

Our understanding of these impacts is communicated across government and with the Collie Coal Mines Environmental Committee. The Department of Water and Environmental Regulation is influencing mine-closure planning discussions to ensure water risks are appropriately identified and managed. A basin-wide approach may be the most effective way to respond to legacy risks associated with coal mining and dewatering.

### Groundwater acidification (acid and metalliferous drainage)

Coal is often associated with sulphidic sediments that naturally exist below the water table. Under normal circumstances they pose very little risk to the environment. Dewatering activities, such as occurs during mining, lower the watertable and expose sulphidic sediments to oxidising processes that produce acidic run-off and release heavy metals when rewet.

When dewatering ceases, groundwater levels recover. As it rises and passes through the acidified soils, groundwater can become acidic with increased soluble metal concentrations.

## The Lake Kepwari flow-through trial

The Collie River South branch was diverted around the WO-5B mine in the 1990s while mining was underway. After mining finished, river water was used to ‘rapid fill’ the WO-5B mine void to reduce water quality issues and create what is now known as Lake Kepwari (Figure 5). However, the void became increasingly acidic with elevated levels of soluble metals, creating a water body with low ecological and recreation value.

The south branch was diverted around Lake Kepwari until 2011, when a significant rainfall event caused the river to overflow into the lake. The lake water quality improved after the overflow, highlighting a unique research opportunity. In 2012, the department collaborated with Premier Coal to trial re-aligning the south branch back through Lake Kepwari with the aim of identifying an alternative approach to mine closure.

The flow-through trial quantified the potential benefits of reconnecting the void back to the natural environment. It confirmed river water improved the water quality of Lake Kepwari and its ecological function by reducing acidity and soluble metal concentrations. There were no significant effects on the hydrology of the Collie River.

Based on the results of the three-year trial and following the operational phase, we understand it will become Premier Coal’s preferred water management strategy for the void. Once surrendered back to the state under the State Agreement process, it is understood the state (through the Department of Biodiversity, Conservation and Attractions) will develop the area into a water-based recreational precinct.

The department will continue to conduct river health assessments downstream of Lake Kepwari to inform management of the river’s ecological condition.



Lake Kepwari

# Status of water use

## Surface water use

Surface water is fully allocated in the Collie River East Branch, Collie River Central, Harris River and Bingham River subareas (Figure 6). Water in Collie River Central and Harris River subareas is licensed for public water supply and agricultural use. All flow from the Bingham River is set aside for the environment, to offset potential impacts to flow from salinity diversion on the east branch.

Although water is available in the Collie River South Branch and Collie River Lower East Branch subareas (Figure 6), updated information and recent changes to stream flow will be considered for licensing applications in these subareas.

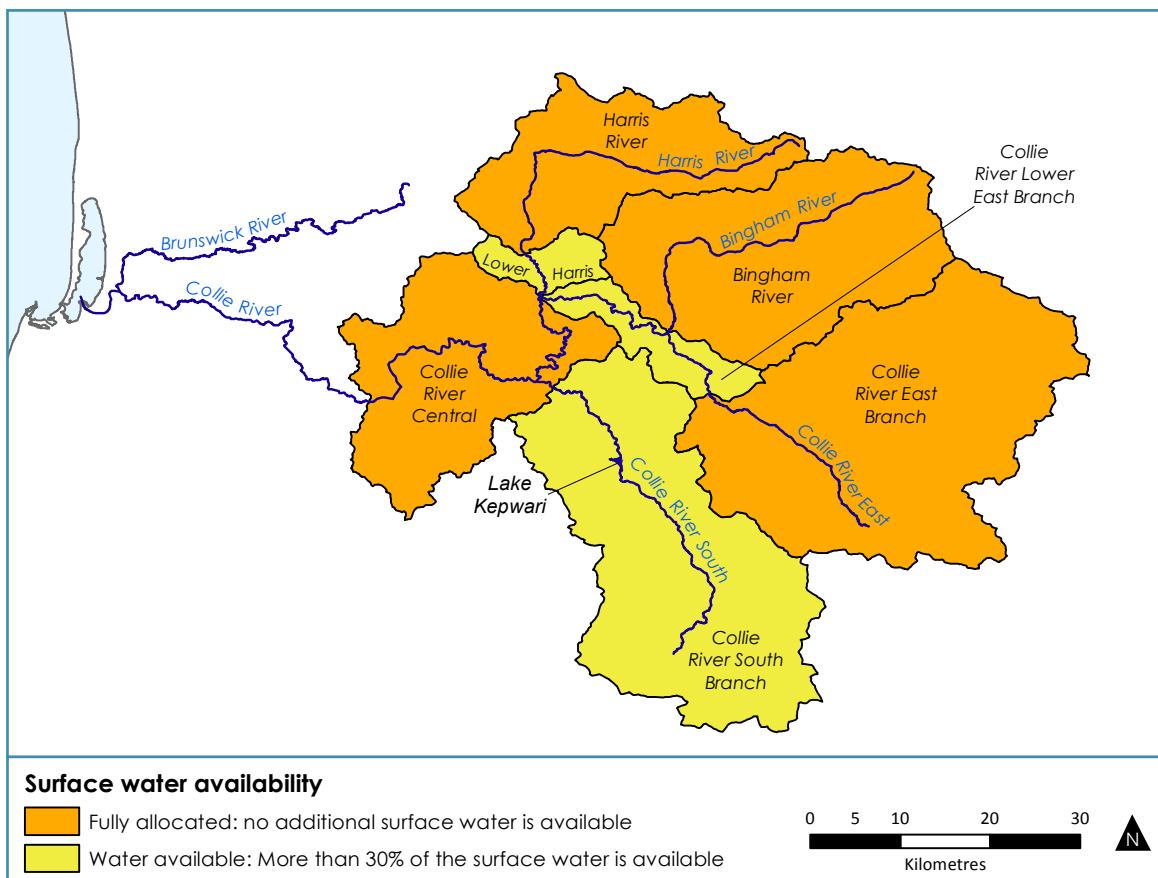


Figure 6 | Surface water availability





Collie River East branch diversion site

## Diversion of the Collie River East branch

The department recently provided conditional approval to Collie Water to divert saline flows from the Collie River East branch as a component of its proposed Myalup-Wellington irrigation scheme. The approval is consistent with the salinity mitigation objectives identified in the Upper Collie plan. The diversion will reduce salinity in the Wellington Dam if it is implemented.

As a key component of this approval, the department set environmental water provisions to support values downstream of the diversion. River health assessments are planned throughout the Collie River catchment to allow ongoing monitoring of ecological condition, which will assist management.

## Use of surplus dewater

Since 2010, a significant component of surface water flow in the Collie River has been provided from the disposal of surplus mine dewater to the Collie River East branch. This masked the stream flow declines resulting from reduced rainfall. It is expected that this surplus dewater will be redirected for power generation use in mid-2018, consistent with the Collie Coal State Agreement Acts and the Upper Collie plan. However, as this will reduce flows downstream of the outfall, the department is working with Premier Coal and Synergy to implement a transition plan to minimise environmental impacts and will continue to conduct river health assessments in the area to inform management outcomes.



Public open space

## Collie town site

The Collie River is important to the Collie township for social amenity and cultural values and the river is the sole source of water used to irrigate public open spaces.

Our recent review of the potential impacts of climate change and changes in the amount of surplus dewater indicates that river flow through the Collie town site may reduce by around 36 per cent. Winter flows will also decline with the diversion of the Collie River East branch for Collie Water’s Myalup-Wellington irrigation scheme.

Our modelling also suggests that monthly average river flow may be especially low during the summer months coinciding with peak irrigation demand (Figure 7).

The department considered that the removal of surplus dewater and salinity diversion is likely to reduce the surface water available for existing public purposes, such as irrigation of parks and ovals, and possibly the amenity of the river itself. We are managing this issue by working with affected stakeholders to identify alternative water source options to meet shortfalls in supply.

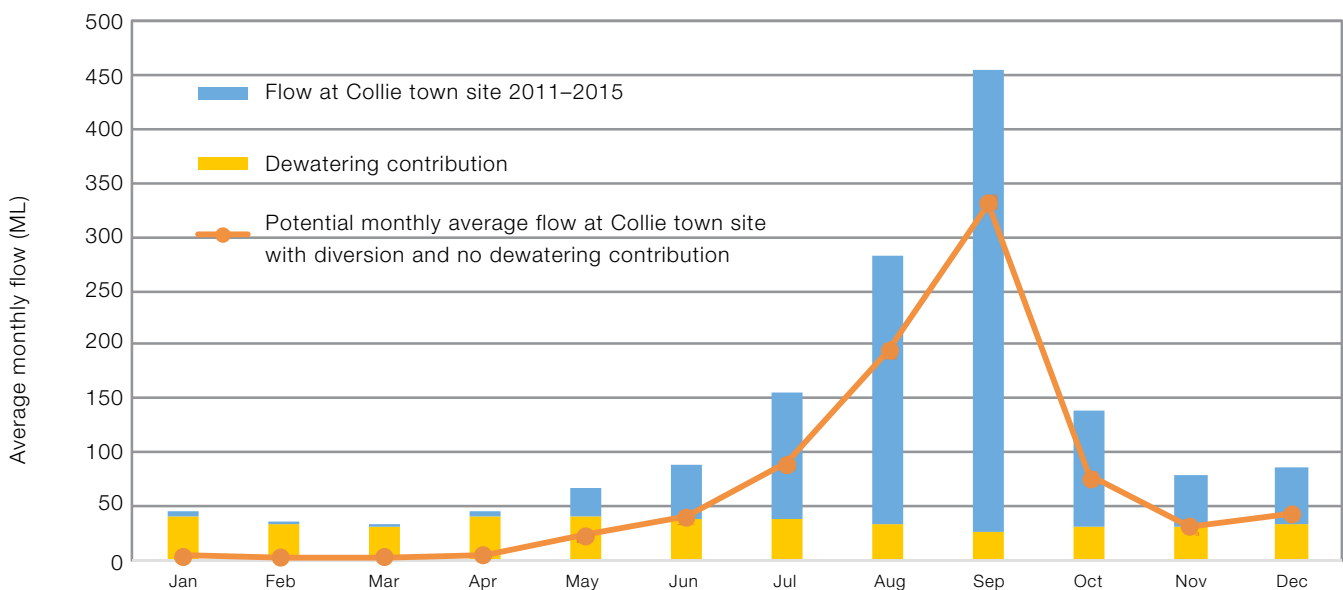


Figure 7 | Monthly average flow modelled at the Collie town site





Wellington Dam

## Evaluating water availability from Wellington Dam

The 2009 Upper Collie plan identified that the 85.1 GL/year allocation limit for Wellington Dam had a 75 per cent reliability of supply. The 2015 *Lower Collie surface water allocation plan*, updated the assessment of reliability and indicated it would likely be lower in the future as a result of climate change.

The department reviewed the Wellington Dam yields and current management. We looked closely at climate change projections, the Collie Water East branch diversion, the redirection of surplus dewater, and current and future use of water from Wellington Dam.

Consistent with the Lower Collie plan, the review identified climate change as the dam's key limiting factor. The allocation limit of 85.1 GL/year will likely have a reliability of approximately 37 per cent by 2030. This means that as we get closer to 2030, the 85.1 GL would only be available approximately one in every three years. As a result of the review, the department is consulting with key

stakeholders to revise the allocation limit and reliability assumptions for the dam. Any update to the allocation limit will be reported in future evaluation statements. No changes will be made to winter release rules needed to protect downstream environments.

## River health assessments

The department will undertake river health assessments in the Collie, Harris and Bingham rivers. The assessments include biological monitoring, particularly fish and crayfish, and water quality monitoring. This will provide a baseline of river condition to support the ecological management of the Collie River and understand the flow-ecology relationships in this modified system.



Marron

# Groundwater use

State Agreements provide for the continual supply of coal to generate electricity for the South West Interconnected System, which supplies electricity from Kalbarri to Albany and to Kalgoorlie in the east.

While dewatering for mining below the watertable results in significant over allocation of groundwater resources, the department works closely with mining companies to ensure use reflects operational requirements.

We developed the *Collie Coal Basin Water Use Balance* tool to track the complex network of water use within and between the coal mining and power generating companies. It shows how much water is used and where (Figure 8). The tool supports our recommendations to the major groundwater licensees for using water in the most effective and efficient way.

Mining and power companies proactively reduce their groundwater take by using water efficiently, relying on multiple water sources, recycling water and managing a desalination plant to meet their total water needs.

Where possible, mine dewater is used instead of taking additional surface and groundwater from the Collie River or the Collie Coal Basin aquifers. Mining companies provide surplus mine dewater to the state’s electricity producers and to the environment to support ecological values.

We anticipate the need to use the recently refined groundwater model to improve our understanding of abstraction in the Collie Coal Basin, particularly in terms of mine closure planning and identified risks.

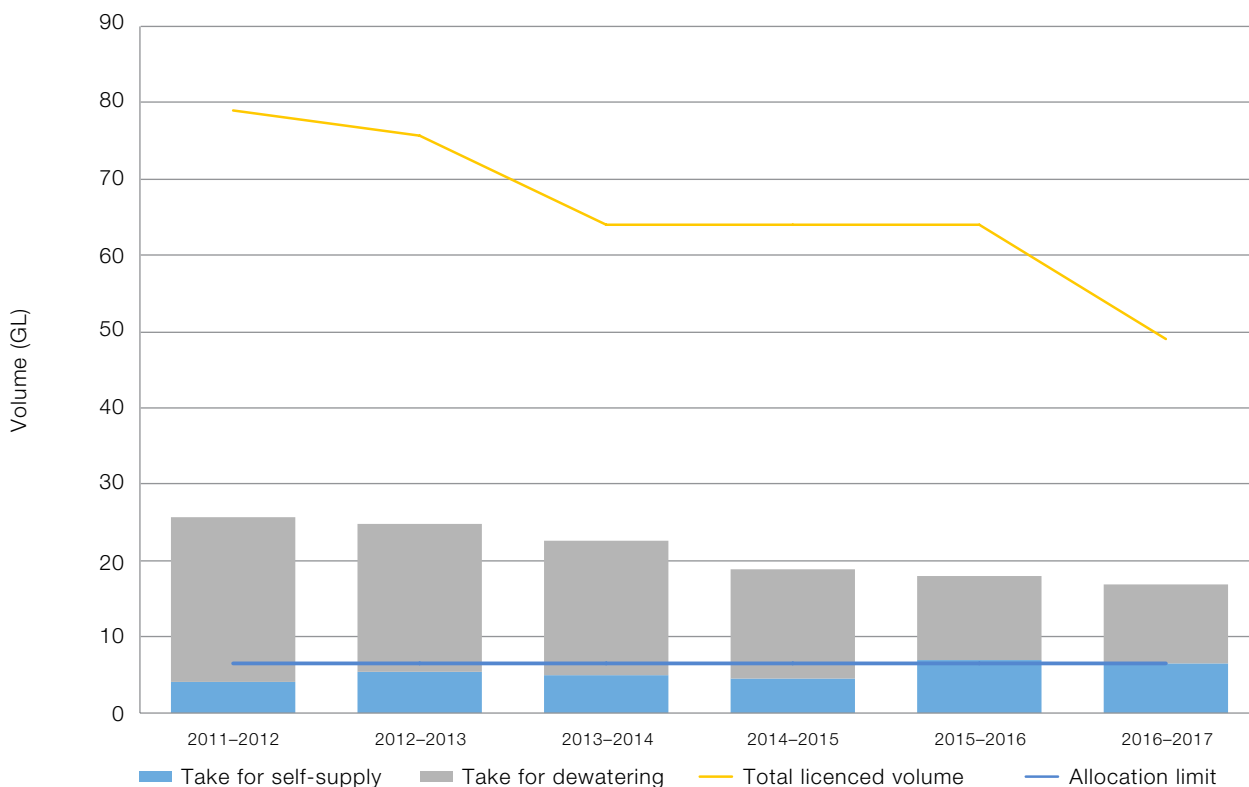


Figure 8 | Total groundwater licences compared to groundwater take in the Collie groundwater area

## Security of supply for power generation

Protecting water supply security for existing licensed water users is an objective of the Upper Collie plan. A large volume of mine dewater currently supports power generation, preventing the need for additional groundwater abstraction.

Dewatering volumes and quality are highly variable due to complex hydrogeology, evolving mine plans and operational changes. Volumes are declining as mining activities decline in the basin.

Synergy has a groundwater entitlement for contingency water needs and as a substitute for dwindling supplies from dewatering. Until a reliable, secure and long-term replacement for dewater is identified by electricity producers, groundwater use will continue and is likely to increase.

Water security for power generation will become critical by 2021. We are working with all stakeholders to develop alternatives for the provision and security of water supply for power generation.

## Myalup-Wellington Water for Food project

Despite variable reliability, the Wellington Dam is a strategic resource in a drying climate. However, high salinity levels mean that the dam is underutilised as a resource, particularly for irrigators in Harvey Water's Collie River Irrigation District.

The \$5.7 million water investigations for the Myalup-Wellington Water for Food project is building on previous studies, including the

Collie River Salinity Recovery project, and has attracted a new industry initiative aimed at improving opportunities for water use above and below Wellington Dam.

For more information about the project, refer to the Water for Food website:

<http://www.waterforfood.wa.gov.au/Projects/Myalup-Wellington>

## Our response and future planning

There are significant water challenges facing the Collie Coal Basin and the Collie River catchment. The department will continue its adaptive and consultative approach to taking all reasonable steps to balance competing needs and values in the plan area.

In continuing to work towards the objectives of the Upper Collie plan and ensuring good water management outcomes we will:

- Continue river health assessments in 2018 to identify the ecological implications of changing stream flows and salinity.
- Assist stakeholders identify alternative water sources where current sources have been or are likely to be reduced, particularly for public open space in Collie and for power generation companies as dewatering volumes decrease.
- Work with the mining industry, by refining monitoring requirements and using our groundwater model, to improve the management of water level and water quality impacts in the Collie Coal Basin.
- Continue to work with the Department of Jobs, Tourism, Science and Innovation through the Collie Coal Mines Environmental Committee on mine closure planning in the Collie Basin. A basin-wide approach will likely be necessary to manage legacy issues associated with coal mining and dewatering.
- Complete re-evaluation of the allocation limit for Wellington Dam to reflect inflows to the dam under a drier future climate.

## Further information

For information on groundwater acidification and acid and metalliferous drainage, visit our website, <https://www.der.wa.gov.au/your-environment/acid-sulfate-soils> or <http://www.water.wa.gov.au/water-topics/waterways/threats-to-our-waterways/acid-sulphate-soils>

For licensing information, please contact our South West regional office in Bunbury, phone 08 9726 4111 or email [bunburyadmin@water.wa.gov.au](mailto:bunburyadmin@water.wa.gov.au).

You can also view the latest water allocation and availability information through our water register via our website: [www.water.wa.gov.au](http://www.water.wa.gov.au).

Information on the *Lower Collie surface water allocation plan* is available from <http://www.water.wa.gov.au/planning-for-the-future/allocation-plans/south-west-region/lower-collie-surface-water-allocation-plan> or email [allocation.planning@water.wa.gov.au](mailto:allocation.planning@water.wa.gov.au).

If you would like to receive updates on allocation planning in the Collie Coal Basin or Collie River catchment, please register your interest by emailing: [allocation.planning@water.wa.gov.au](mailto:allocation.planning@water.wa.gov.au)