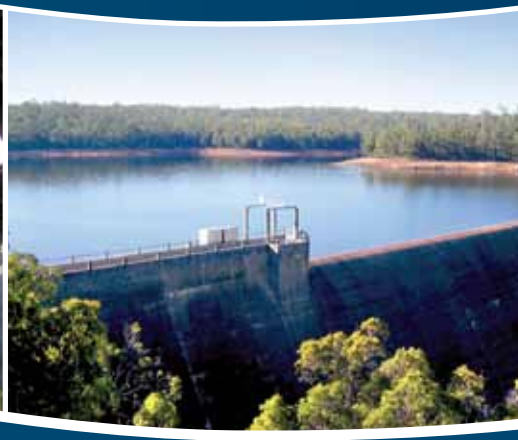
Government of **Western Australia**
Department of **Water**

Upper Collie

water allocation plan





Looking after all our water needs

Water resource allocation
and planning series
Report no. 20
August 2009

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For more information about this report, contact the Program Manager of Allocation Planning, South West regional office.

Water resource allocation planning series
Report no. 20

Foreword

Water allocation planning is a high priority in the Upper Collie catchment given the increasing water demand for power generation, industry and public water supply, as well as the need to protect the natural environment.

The Upper Collie water allocation plan provides the necessary management approach for allocating surface water, groundwater and mine dewater resources to these competing users.

This plan is a strategic document and will ensure that the relationship between mining, power generation and industry, with their direct impact on water resources, is managed equitably and for the wellbeing of the catchment.

The Department of Water has developed the plan with input from stakeholders and the community and will promote balanced decision making and improve outcomes for the environment, industry and the community.

Kim Taylor
Director General, Department of Water

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Summary

What is this all about?

Water has been abstracted from the Upper Collie surface and groundwater areas (Upper Collie) resources for over a century. How we manage the modified water resource to meet new demands, within the constraints of maintaining a sustainable system, is increasingly challenging. Part of the challenge, to address the salinity issues in the Upper Collie, is beyond the scope of this allocation plan. Although this plan's focus is on water allocation, it is intended to complement plans for the recovery of water quality in the Wellington Reservoir.

By following this plan we can take a strategic approach to water allocation and licensing so that short-term decisions support the longer term direction. This ensures that we make the most of the water that is abstracted while providing enough to maintain the environment and leave options for the future.

What does this allocation plan do?

This plan provides the basis for allocating water from the Upper Collie water resources under the existing supply and demand scenario. It provides a solid framework for optimally allocating water without a stream diversion, treatment plant, desalination plant, or water utility. The plan considers the current water resources and their current water quality and how we should allocate water from them.

This plan provides the objectives, positions and policies for allocating water. It builds on and supersedes previous water allocation principles established by the Collie Water Advisory Group in 1996 and 1999. The plan also includes performance indicators by which it will be evaluated over time.

What are the resources of the Upper Collie?

The Upper Collie contains surface water, groundwater and mine dewater from the Collie Coal Basin. These resources have supplied the local power industry, mining industry, public water suppliers and irrigators for many decades. Demands are increasing as new power stations and industries are proposed for the region.

What is the strategy for the water resources?

The Wellington Reservoir is a marginal quality resource which is currently underutilised. The department encourages new and expanding industries to access this for fit-for-purpose uses. The department is currently implementing a salinity recovery program to improve the quality of the Wellington Reservoir.

Summary

The Harris Reservoir is a high quality resource which is fully allocated to the Water Corporation for the provision of public water supply to the Great Southern Towns Water Supply Scheme. While water may be used to supplement other sources opportunistically, it is a fully committed source and no further water is available for allocation.

The groundwater resources of the Collie Coal Basin are divided into two subareas, the Cardiff and the Premier.

Groundwater from the Cardiff subarea was previously over-abstracted and now supplies the state's existing power stations at a rate that allows for recovery of groundwater levels. No further groundwater is available for allocation.

Groundwater from the Premier subarea is dewatered to allow for safe coal mining activities. The surplus mine dewater is of high quality and is used by power stations. To optimise this resource the department supports its re-use by other parties.

This plan emphasises the importance of accountability of water users for their water use and the impacts of that use. All water users are expected to manage the impacts of their water use through appropriate mitigation measures.

How did the Department of Water develop this plan?

Our *Upper Collie water allocation plan* builds on over a decade of research, assessment and modelling of water resources. In 2007, we examined issues for Collie water allocation and use with representatives from industry, irrigators, water service providers, local authorities, landowners and conservation groups.

In 2008, we held a three-month public comment period on the *Upper Collie water allocation plan: draft for public comment*. From this point we received 21 submissions that we considered in finalising the *Upper Collie water allocation plan*. For information on the submitted comments and our responses please see the *Statement of response: Upper Collie water allocation plan for public comment.*

Part one

background and considerations

Chapter one

Background

1.1 Scope of the plan

This water allocation plan sets out how the Department of Water will allocate and manage the use of water in the Upper Collie surface water and groundwater areas (Upper Collie). The plan is in line with our jurisdiction for water planning under the *Rights in Water and Irrigation Act 1914 (RiWI)*. Where state agreements apply in the Collie area, we have designed our management framework to comply with them.

This plan details:

- the surface and ground water allocation planning boundaries, by subarea and resource
- the objectives for the allocation of water
- the strategies to reach the allocation objectives including:
  - annual allocation limits for each resource
  - the department's positions on how water will be allocated
  - licensing and allocation policies
- how we will evaluate and review the plan.

1.2 Purpose of the plan

This plan responds to the need to provide clear and consistent direction to current and future water users and to address allocation issues.

The drivers for this plan are:

- the need for accountability and responsibility for use of water resources
- increased coal mining activity and mine dewatering
- increased water demand for power production and other regional industries
- the need to ensure equitable access to dewatering water, while complying with state agreement Acts
- the need to recover groundwater levels post-dewatering activity
- the salinity recovery program for Wellington Reservoir
- the existing and potential environmental impacts from water abstraction
- community concern over water management
- the need for a consistent approach to water management in the area.

This plan sets a direction to optimise the use of available water. Resolving future water supply options, for example through stream diversion and desalinisation, is beyond the scope of this plan.

1.3 The plan area

Location

The Upper Collie surface water and groundwater areas (Upper Collie) are located around 200 kilometres south of Perth, in the south-west of Western Australia (see Figure 1). The Upper Collie surface water and groundwater areas cover the upper reaches of the Collie River catchment. The Upper Collie planning boundary ends at the Wellington Dam wall.

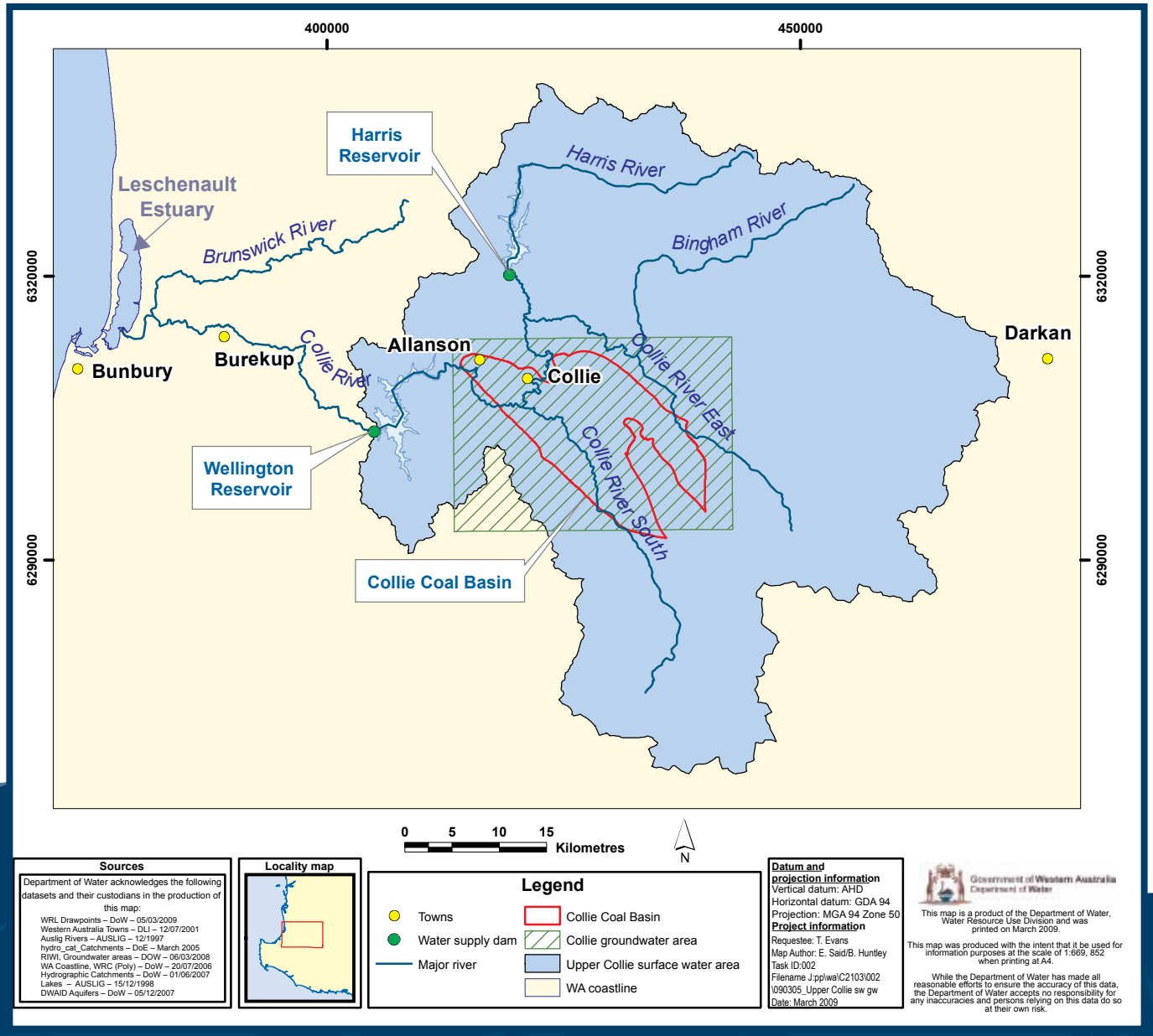


Figure 1
Location of the Upper Collie surface water and groundwater areas

Allocation units

Surface water resources

Upper Collie surface water area is within the proclaimed Collie River Irrigation District and includes the main stream of the Collie River, the Collie River south and east branches and the Bingham and Harris rivers. The Collie and Harris rivers have been dammed to create the Wellington and Harris reservoirs (Figure 2).

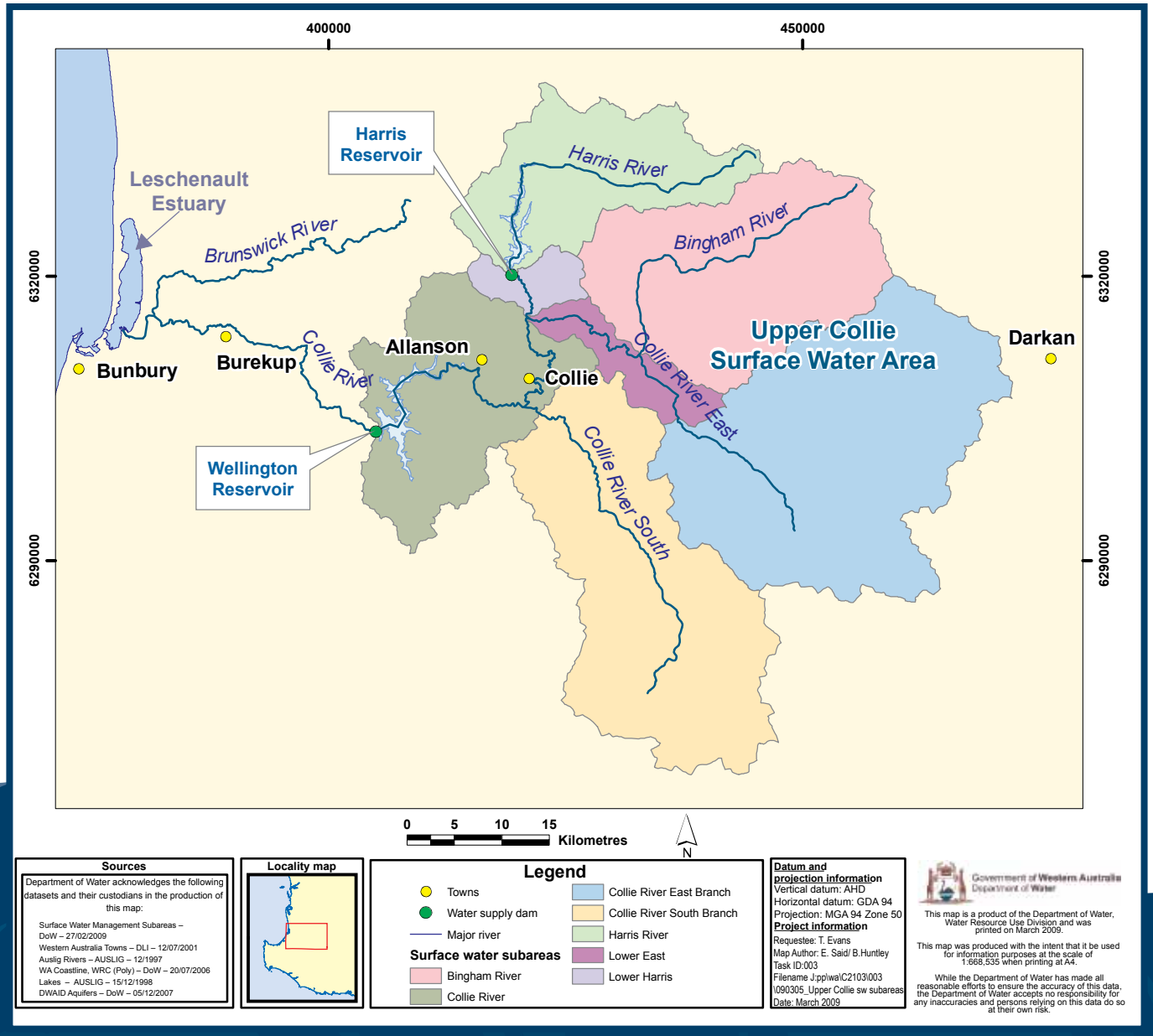


Figure 2
Surface water resources and their allocation units

The department manages surface water according to seven subareas, each with an individual allocation limit. The subareas are:

- Collie River Central (containing the Wellington Reservoir)
- Harris River (containing the Harris Reservoir)
- Lower Harris
- Collie River East Branch
- Collie River Lower East Branch
- Bingham River
- Collie River South Branch.

Figure 2 shows the surface water resources and their planning boundaries.

Groundwater and mine dewater resources

The proclaimed Collie groundwater area covers the groundwater of the Collie Coal Basin. The Collie Coal Basin has two distinct subareas, the Cardiff and the Premier, separated by the Stockton Ridge formation (Figure 3).

The department manages groundwater in the Cardiff and the Premier subareas as four resource groups – the Nakina, Muja, Lower Collie Group and Stockton. An allocation limit applies to each resource within each subarea.

Mine dewater is abstracted above the groundwater allocation limits within the Premier subarea. The surplus dewater is considered to be a resource but it is not re-allocated up to an allocation limit. It is reused on an opportunity basis and within the licensed entitlement.

The area outside the Collie Coal Basin, but within the proclaimed groundwater area, has no significant water resources. Some areas of fractured rock aquifers may exist. The groundwater resources of the Wilga Basin are not included within the proclaimed Collie groundwater area, so they are not included in this plan.

1.4 Surface water

Surface water quality and condition

The condition of the seven Upper Collie surface water subareas is highly varied. The Bingham subarea remains in a natural state. All other subareas have experienced significant modifications to the natural surface water flow regime through catchment clearing and are regulated by the Harris and Wellington dams.

Land clearing in the eastern and southern portion of the catchment has led to dryland salinity, with increased saline water inflow to streams. As a result, water quality in the Collie River and in the Wellington Reservoir has deteriorated. The Collie River East Branch contributes the highest salt load to the Wellington Reservoir. A salinity recovery program is underway, to improve water quality in the Wellington Reservoir, by diverting saline inflows from the Collie River East Branch. The Harris and Bingham rivers provide a valuable, seasonal input of fresh water to the Collie River system. Land clearing has also increased flows compared to fully forested catchments. Higher flows have resulted in river channel erosion and the sedimentation of downstream river pools. This is particularly evident along the Collie River East Branch.

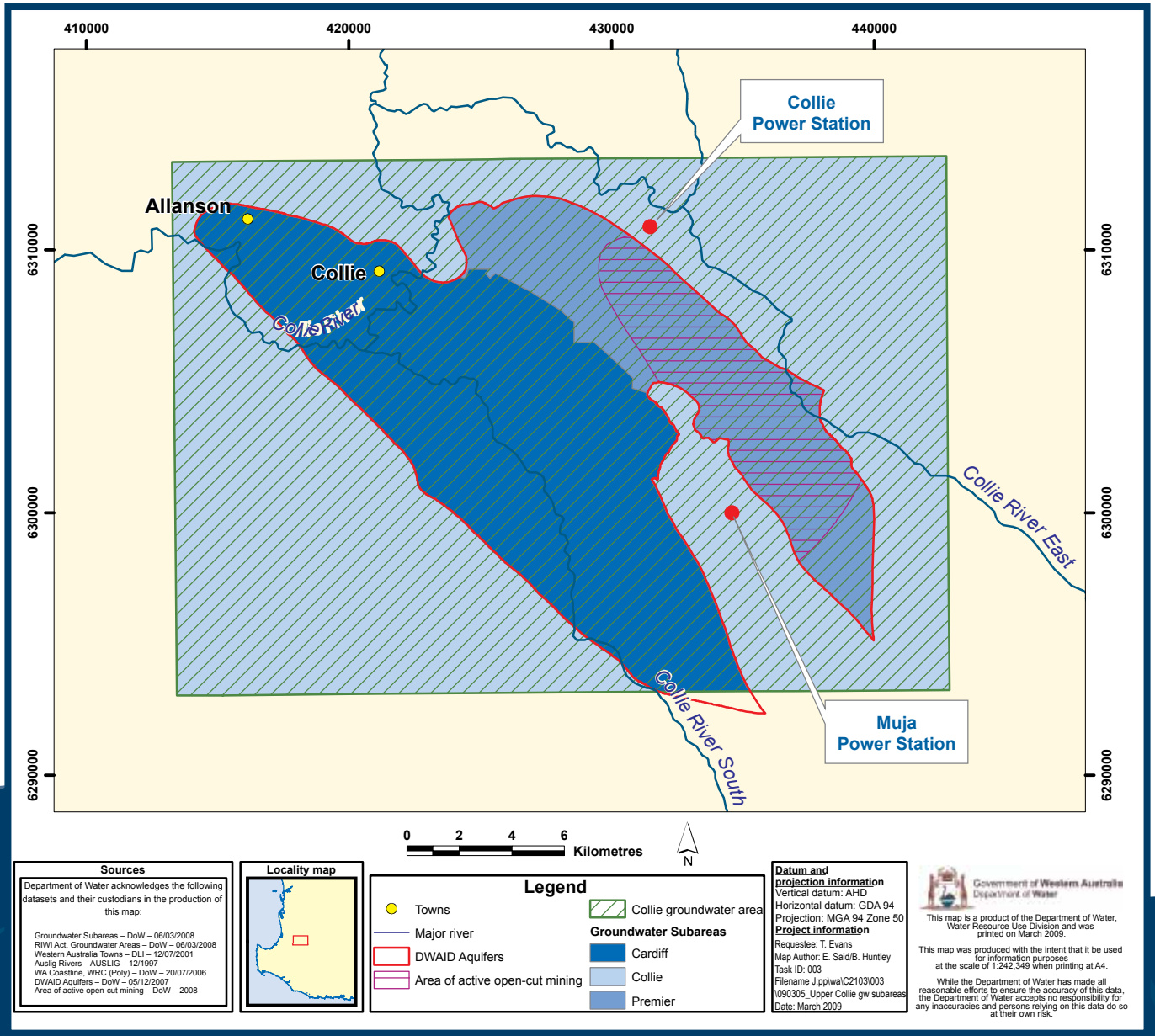


Figure 3
Groundwater management boundaries

Water licensing and use implications

- We have set surface water allocation limits to restore fresh water to the Collie River, remove salt from the system and provide riverine ecology with fresh water.
- A partial diversion of Collie River East Branch is necessary to reduce saline inflows to the Collie River Central subarea and the Wellington Reservoir.
- The freshwater contribution of the Bingham River is important for maintaining the downstream health of the Collie River that is affected by salinity.

Annual and seasonal variation in flows

Streamflow in the Upper Collie is seasonal, with highest flow occurring over the winter months when rainfall is highest. During summer, in most parts, the Upper Collie rivers and streams naturally cease to flow. Larger rivers (Collie East and South Branch) become a series of river pools that are dependent on groundwater to maintain their water level.

Streamflow varies each year. To reflect annual variability in flows, percentage reliability applies to each allocation limit. The reliability indicates that allocations may not be achieved in all years because the water will not be available during dry years. Conditions on operating strategies and licences reflect the annual variation and reliability of the related system.

Over the past 30 years there has been a trend of reducing rainfall. If the trend of drying climate continues, the reliability of allocations may reduce further.

The hydrological characteristics and processes associated with stream salinity are documented in detail in the *Salinity Situation Statement: Collie River Water resource technical series 29 (Water and Rivers Commission 2001).*

Further information on the hydrologic characteristics is given in *Managing water in the Upper Collie (Department of Water 2007)* which can be found on the department's website <www.water.wa.gov.au> or by contacting the Department of Water.

Water licensing and use implications

- A 'period of take' rule applies to surface water licences in the Upper Collie. This means the department generally only permits abstraction during the winter flow period.
- Operating strategies for the Wellington and Harris reservoirs need to provide for the release of water throughout the year to meet downstream ecological and social water needs.
- We have based allocation limits and reliabilities in this plan on rainfall and streamflow data from 1975 to 2003. If the drying climate trend continues, the reliability and security of supply will decrease for all water users. We may also reduce allocation limits to reflect this in the future.
- Surface water licences within each subarea will have a reliability based on the reliability of the subarea.

1.5 Groundwater

Groundwater quality and condition

The hydrogeology of the Collie Coal Basin is complex, with multiple aquifers separated by shale and coal seams with numerous faults throughout. The hydrogeological characteristics, recharge components and the water balance are documented in detail in the *Hydrogeology and groundwater resources of the Collie Basin, Western Australia, Report Hydrogeological record 5 (Varma 2002).*

The groundwater system of the Collie Coal Basin is highly modified. Underground and open-cut coal mining has occurred in the Collie Coal Basin since 1898. In the Cardiff subarea there are underground and open-cut coal mines that are no longer in operation and the groundwater levels are recovering. In the Premier subarea, open-cut coal mining is active and large scale dewatering from the Lower Collie Group aquifers is likely to continue in the long term.

Long-term and large-scale abstraction for power station water supply, particularly from the Cardiff subarea, has also modified the groundwater system.

Groundwater quality in the Collie Coal Basin is generally fresh, with salinity less than 500 mg/L total dissolved salts (TDS). However, salinity of greater than 1000 mg/L TDS has been observed in some places which are likely to receive recharge from rivers. With increased abstraction, as is expected in the Premier subarea, increased recharge from the Collie River East Branch is likely to occur and groundwater quality in some parts is likely to decrease.

Groundwater is generally acidic due to its contact with sulphide-bearing sediments. This is evident in the Cardiff subarea in areas of abandoned underground and open-cut mine voids. As groundwater levels recover from over-abstraction there will be an increase in groundwater discharge to rivers which may alter the acidity of the Collie River. This has the potential to mobilise pollutants, such as heavy metals, which could enter the river system.

Water licensing and use implications

- Recovery of groundwater levels in the Cardiff subarea is necessary to maintain ecosystem health, including health of groundwater-dependent river pools and security of supply for current users.
- Licences are required to monitor groundwater quality (including salinity and acidity).
- Water quality will be considered in allocation decisions and assessment of dewater release options.

Groundwater levels

Abstraction in excess of annual recharge has lead to a basin-wide decline in groundwater levels by around 1 m across the Collie Coal Basin. In some parts the watertable is more than 50 m below its estimated pre-mining state. This has resulted in alterations to groundwater flow patterns, induced recharge to the confined aquifers and reduced discharge to the Collie River.

With large scale dewatering in the Premier subarea, groundwater levels will continue to decline. This will reduce both the volume of water that is abstracted and, eventually, the need to dewater.

Water licensing and use implications

- The department requires groundwater users to monitor and mitigate the negative impacts of their water use. This includes pool supplementation on the Collie River south and east branches, where pool levels have been affected by groundwater drawdown.
- The current allocation limits allow for the Cardiff subarea groundwater levels to recover over time. The department only permits over-abstraction of the Premier subarea to allow for safe mining practices. We will not issue licences for abstraction over the allocation limit, except for dewatering requirements.
- Over time the amount of surplus water from dewatering activity will reduce and eventually cease. Water users reliant on surplus dewater will need to ensure they have completed good source planning and develop other sources as required.

Connectivity between subareas

The Cardiff and Premier subareas are divided by an impermeable granite ridge known as the Stockton Ridge. However this ridge is absent in some locations.

Although the Cardiff and Premier subareas are discrete units, a saturated layer exists between the two subareas. This means a small amount of water could cross over in areas where the Stockton Ridge is absent. Large scale abstraction in one subarea could influence groundwater flow patterns and levels in the other subarea.

Water licensing and use implications

- The department considered the impacts of abstraction and connectivity between subareas when it sets allocation limits.
- License applicants are required to assess the potential impact across both subareas that may result from large scale groundwater abstraction.

Aquifers

Each subarea contains eight distinct aquifers – the Nakina, Muja, Premier, Allanson, Ewington, Westralia, Moorhead and Stockton. There is a high degree of connectivity between certain aquifers, so the department manages each subarea as four resource groups – the Nakina, Muja, Lower Collie Group and Stockton. A hydrogeological cross-section of the aquifer and aquifer groups is shown in Figure 4.

The Nakina aquifer is the unconfined (or superficial) aquifer as it has no overlying confining layer and outcrops across both subareas. The Nakina formation thickness is highly variable and is at its thickest toward the valley floors. The thickness and presence of a saturated profile means the Nakina is sometimes considered as an 'aquifer', otherwise it is described as the platform for recharge and evaporation processes.

The Muja, Lower Collie Group and Stockton aquifers are managed as confined aquifers. However, each of these confined aquifers subcrop beneath the Nakina aquifer at various points.

Groundwater enters the Muja, Lower Collie Group and Stockton aquifers as leakage from the Nakina aquifer in areas of subcrop. Water eventually discharges back into the Nakina aquifer in an area of subcrop that underlies the Collie River. All of the aquifers are hydraulically connected.

In a pre-disturbance state the Muja, Lower Collie Group and Stockton aquifers would be confined by thick coal seams, shale and siltstone. It is unlikely that any significant flow of groundwater would have taken place from one aquifer to another. However, mine dewatering and other large scale groundwater abstraction has resulted in significant aquifer pressure head differences resulting in large volumes of leakage from one aquifer to another.

The general hydrogeological characteristics of the resources of the Cardiff and Premier subareas are provided in Table 1.

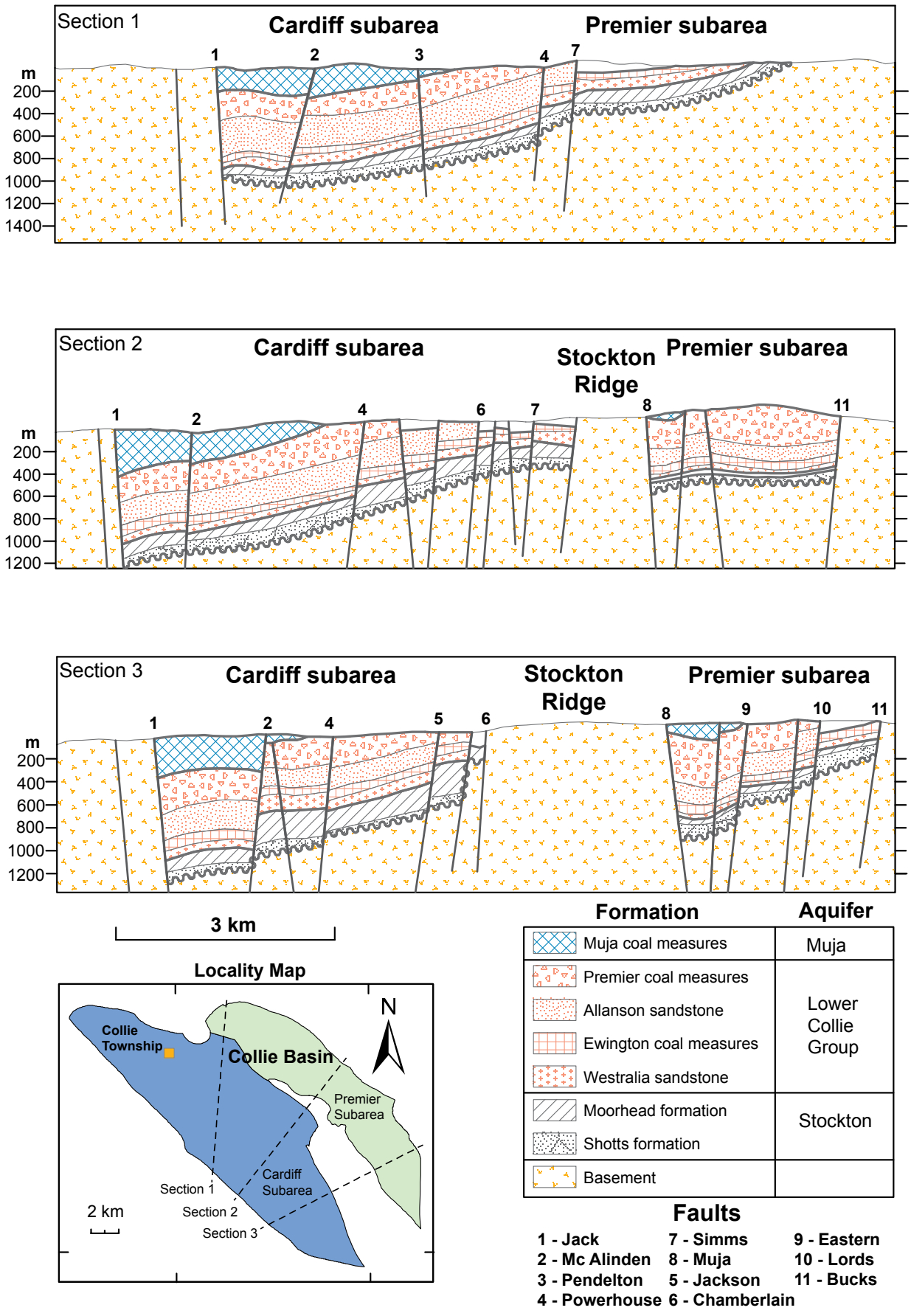


Figure 4
Hydrogeological cross-section of the Collie Basin

Table 1
Characteristics of the groundwater resources of the Cardiff and Premier subareas

Resource	General description	
	Cardiff subarea	Premier subarea
Nakina	• Unconfined aquifer (superficial) • Comprises the Nakina Formation and the superficial sediments • In direct hydraulic connection with all underlying aquifers • Discharges to the Collie River South Branch – contributes to the maintenance of summer water levels in groundwater-dependent river pools • Sandstone and mudstone sediments • Poor water yield • Maximum thickness 20 m • Unsaturated in the south-eastern part where abstraction occurs from the Cardiff borefield	• Unconfined aquifer (superficial) • Comprises the Nakina Formation and the superficial sediments • In direct hydraulic connection with all underlying aquifers • Discharges to the Collie River East Branch – contributes to the maintenance of summer water levels in groundwater-dependent river pools • Sandstone and mudstone sediments • Poor water yield • Maximum thickness 15 m • Generally unsaturated in the central and southern parts where mining occurs
Muja	• Confined aquifer • Contains the Muja aquifer • Sandy sediments and good water yield • In direct hydraulic connection with overlying Nakina aquifer • Present only in the subarea centre • Maximum thickness 450 m • Contributes to the maintenance of summer water levels in groundwater-dependent river pools (Long, Walker, B. Cox, Cardiff, Graham)	• Confined aquifer • Contains the Muja aquifer • Sandy sediments and good water yield • In direct hydraulic connection with overlying Nakina aquifer • Only located in the southern corner of the subarea, where it has been dewatered through the Muja mine • Maximum thickness 250 m

Table 1
Characteristics of the groundwater resources of the Cardiff and Premier subareas

Resource	General description	
	Cardiff subarea	Premier subarea
Lower Collie Group	• Confined aquifers • Contains the Premier, Allanson, Ewington and Westralia aquifers • In direct hydraulic connection with overlying Nakina aquifer • Overlies the Stockton aquifer • Sandy sediments and good water yield • Contributes to the maintenance of summer water levels in Chinamans pool, due to connection with the Premier aquifer • Maximum thickness ~ 600 m • Maximum depth of 1100 m	• Confined aquifers • Contains the Premier, Allanson, Ewington and Westralia aquifers • In direct hydraulic connection with overlying Nakina aquifer • Overlies the Stockton aquifer • Sandy sediments and good water yield • Contributes to the maintenance of summer water levels in groundwater-dependent river pools (Duderling and Buckingham) • Maximum thickness ~ 400 m • Maximum depth of 700 m • Heavily abstracted for dewatering purposes
Stockton	• Contains the Stockton aquifer only • Confined aquifer • Mudstone sediments • Low water yield • Maximum thickness 370 m • Maximum depth of 1300 m • Formed by the Shotts and Moorhead formations • Confined from below by granitic basement • Limited information available	• Contains the Stockton aquifer only • Confined aquifer • Mudstone sediments • Low water yield • Maximum thickness 50 m • Maximum depth of 900 m • Formed by the Shotts and Moorhead formations • Confined from below by granitic basement • Limited information available

Water licensing and use implications

- Given the degree of hydraulic connection and leakage, large-scale abstraction from one aquifer will affect other aquifers.

Groundwater recharge and discharge

The groundwater balance, including recharge, discharge and storage components (after mining activity and disturbance), was assessed by the department in 1999. This allocation plan was developed using the department's 1999 groundwater model. At the time of the assessment the volume of groundwater stored within the basin was estimated to be 7100 GL, with an annual recharge of around 19.4 GL/yr. The model and its components are documented in *Groundwater Model of the Collie Basin, Western Australia, Report Hydrogeological record 15* (Zhang et al 2007).

The groundwater balance schematic is provided in Appendix K.

The amount of rainfall recharge to the Collie Coal Basin has been estimated at 18.7 GL/yr. This is approximately 10 per cent of the average rainfall from 1979 to 1999 (840 mm). In addition to recharge from rainfall, the Collie Coal Basin also receives a small amount (0.7 GL/yr) of recharge from the Collie River east and south branches, giving a total recharge estimate for the Collie Coal Basin of 19.4 GL/yr.

Of the 19.4 GL/yr of recharge to the Collie Coal Basin:

- 1.9 GL/yr enters the unconfined Nakina aquifer where it discharges out of the system directly into wetlands and the Collie River south and east branches.
- 12.5 GL/yr enters the confined Muja, Lower Collie Group and Stockton aquifers of the Cardiff subarea. Up to 3.6 GL/yr leaks upwards into the Nakina aquifer where it discharges out of the system. The recharge (minus discharge to other aquifers) for the Cardiff subarea is 8.8 GL/yr.
- 5 GL/yr enters the Muja, Lower Collie Group and Stockton aquifers of the Premier subarea. Up to 0.13 GL/yr leaks upwards into the Nakina aquifer where it discharges out of the system. The recharge (minus discharge to other aquifers) of the Premier subarea is 4.87 GL/yr.

Water allocation and use implications

- The department manages the system according to its present state, as assessed in 1999, not its pre-mining state.
- As Cardiff groundwater levels recover and Premier groundwater levels decline further, the balance of recharge and discharge within aquifers will change. Each subarea may then require new allocation limits.
- We developed allocation limits for the groundwater resources in this plan by considering net recharge, which is, the total volume of water entering the system through recharge minus the total volume of water leaving the system through discharge.
- Groundwater that discharges from the system contributes to river baseflow, maintains river pools and supports wetland ecology and has been set aside to maintain the values of these systems.

1.6 Ecological values

The ecological condition varies throughout the Upper Collie. The Upper Collie river system has been affected by over 100 years of mining activity. Land clearing has also significantly altered the condition of the system. In some areas of the upper catchment, native fish, tortoise, and marron populations are known to exist, but in some parts of the catchment there is no information about the natural ecological state.

Areas such as the Collie River East Branch have been affected by land clearing, loss of riparian vegetation and salinity. Salinity has had a major impact on river health in the Collie River Central, South Branch, Lower East and East Branch subareas, affecting both biodiversity and ecological processes. The basin-scale ecological impacts of salinity and industrial activity in the Collie have not been studied in detail and are not well understood.

The Harris and Bingham subareas are largely forested. Fresh water from the Harris and Bingham rivers is crucial to maintaining aquatic ecology in these subareas as well as alleviating salt-stress on aquatic fauna and flora downstream, where water is marginal to brackish.

The ecology of the Harris River, downstream of the Harris Reservoir, is maintained by the environmental releases of water from the reservoir. Below the Wellington Reservoir, ecological flows are met by irrigation releases during summer months and scour releases during winter.

Within the Collie Coal Basin the location and water requirements of groundwater-dependent ecosystems are not well documented.

Water licensing and use implications

- The Upper Collie allocation limits take into account water that is needed to maintain the ecology of surface and groundwater-dependent systems.
- Water is released from the Wellington and Harris reservoirs to minimise ecological impacts of large storage and use.
- Fresh water inflows from the Bingham River are vital to maintain the ecology in the Upper Collie. Water will not be diverted from this system.
- Recovery of Cardiff groundwater levels will ensure groundwater-dependent river pools are maintained naturally, all year round.
- Water users (of more than 0.5 GL/yr) must develop impact management plans to identify and address all potential impacts associated with their abstraction.

1.7 Cultural values

The Upper Collie rivers and wetlands, their surrounding landscapes and story lines are important to the cultural and spiritual beliefs of Aboriginal people. The Collie River is a registered Aboriginal Heritage site.

More information on the cultural values of the Collie River is available in *A report on conferences held with the Nyungar community by the Department of Water for the South West water plan, Western Australia* (Goode and Associates 2007).

Water licensing and use implications

- The Department of Water is committed to consulting with the traditional owners of 'country' to ensure that proper attention and respect is given to Indigenous heritage issues in water management.
- In the Collie district, appropriate representatives from the local Indigenous community are encouraged to provide formal input to matters of Aboriginal interest. Elders and custodians are identified by their own people for their special knowledge and status, which entitles them to speak for 'country' when required.
- The local Indigenous community has expressed concern over the mixing of surface and groundwater, the lowering of the watertable, the impact of mine dewatering within the Upper Collie, and private enterprise generating profits at a cost to Indigenous values.

1.8 Community concerns

The Collie community has expressed interest in a number of important water management issues relating to water use and allocation within the catchment.

Community issues raised during consultation for this plan are documented in the *Upper Collie water allocation plan – issue scoping report* (Beckwith 2007). Community issues have also been documented in *the Environmental water requirement study – Harris River and East Branch of the Collie River (downstream of the confluence) to the South Branch* (Welker and Streamtec 2000).

Optimising use of the Wellington Reservoir and water source protection

The future use and allocation of the Wellington Reservoir concerns the community in two ways: firstly, that Wellington Reservoir is currently underutilised and secondly, if Wellington Reservoir becomes a public water supply source, recreational activities on and around the reservoir may be restricted.

Water licensing and use implications

- The department is working towards optimising the use of the reservoir by implementing the salinity recovery program and by encouraging regional industries to apply for the fit-for-purpose water.
- The department endorses current approved levels of recreation on the Wellington Reservoir, with no further expansion. All options for water treatment will be investigated before we change any policies relating to recreation at the reservoir.

The release of water from the Wellington and Harris reservoirs

Water released for irrigation and scoured from the Wellington Reservoir supports a modified downstream environment and associated social values (such as canoeing and Aboriginal heritage).

Water is released from the Harris Reservoir to maintain environmental flows. It is released according to a regime defined in the Water Corporation's operating strategy for the reservoir. In addition to releases made for environmental needs, water has been released from the Harris Reservoir to manage the salinity of the Wellington Reservoir. This release is referred to as a 'salinity mitigation release' and has occurred in 1998, 1999 and 2003.

The local community is concerned that a reduction or change in the release amounts, from the Wellington and Harris reservoirs may affect downstream river values.

Water licensing and use implications

- Water is released from both Wellington and Harris reservoirs to maintain downstream river values.
- With the salinity recovery plan in place salinity mitigation releases from the Harris Reservoir may no longer be required.
- Release strategies from both Wellington and Harris are under review to ensure that ecological water requirements are met.

Poor water quality of Collie River East Branch

The poor water quality and condition of the Collie River East Branch concerns the community because it constrains land use potential and impacts on the ecological health of the Upper Collie river system.

Effect of groundwater over-abstraction

Over-abstraction of groundwater for mine dewatering and the associated environmental impacts are major concerns for the community. The future of the river pool supplementation programs along the Collie River south and east branches is also a concern for local landowners.

Water licensing and use implications

- The Department of Water expects major water users to identify and mitigate the impacts of their water use. This includes pool supplementation of groundwater-fed pools that are affected by groundwater drawdown.

- The Department of Water supports the supplementation of Cardiff Town Pool (Collie River South Branch) and Duderling Pool and Buckingham Bridge / Town Pool (Collie River East Branch). Supplemented water must be of a suitable quality that will not adversely affect the quality or condition of the river.

1.9 Surface water use and availability

Current use of surface water

Surface water resources of the Upper Collie supply both local and regional demands.

The Harvey Water irrigation cooperative holds a licence for 68 GL/yr to abstract water from the Wellington Reservoir. This is the largest single licensed allocation within the Upper Collie.

The Water Corporation holds a licence for 15 GL/yr to abstract water from the Harris Reservoir to supply the drinking water needs of the Great Southern Town Water Supply Scheme. The Water Corporation has previously supplied regional industries, such as Verve Energy and Worsley Alumina, with water from the Harris Reservoir in emergency situations.

Surface water from the Collie River South Branch is also diverted to maintain the water level of Lake Kepwari, previously an open-cut coal mine.

Salty (saline) surface water from the Collie River East Branch has been diverted to reduce the salt load into the Wellington Reservoir.

Surface water is also pumped directly from the river to supply viticulture, irrigate turf and for riparian rights (stock and domestic needs only).

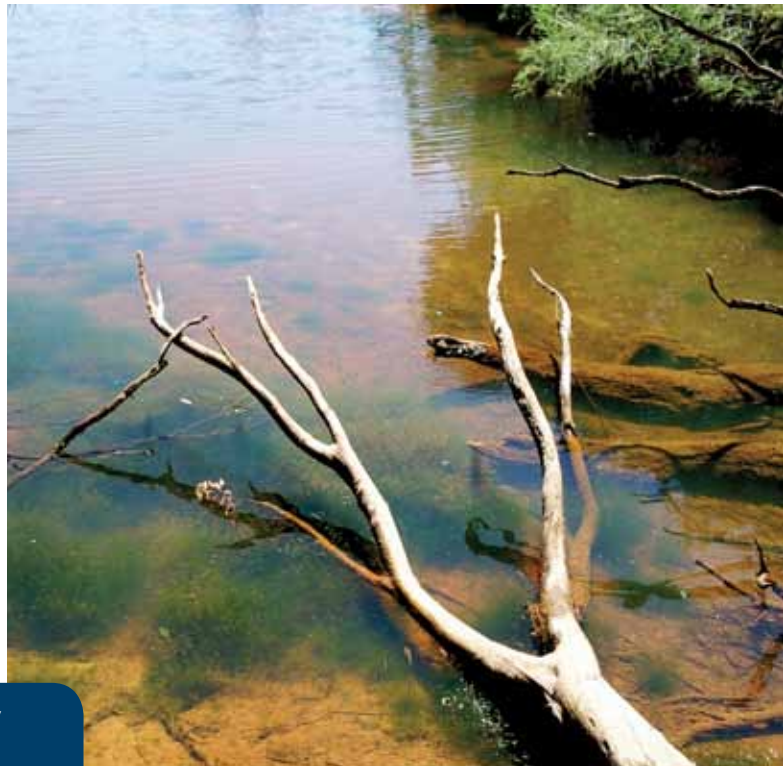
There are some properties in the Upper Collie that are permitted to use small quantities of surface water for stock and domestic purposes. This use does not require a licence under the *Rights in Water and Irrigation Act 1914 (RiWI Act)*.

The department has estimated that a total of 0.57 GL/yr of surface water is used for stock and domestic purposes. Estimates of stock and domestic use for each of the surface water subareas are provided in Table 2 (as unlicensed use). These estimates are based on the likely water requirements (10 kL/yr) for non-intensive grazing and sheep farming (one head of stock per hectare), which is the predominant land use.

Future use of surface water

We expect that demand for water from the Harris and Wellington reservoirs will increase in the future.

Harris Reservoir has a large storage capacity compared to its mean annual flow. As a result, the Harris Reservoir could be used as a temporary storage for additional water, such as surplus mine dewater, that could be transferred to the Integrated Water Supply Scheme.



Allocation limits and available water

Water available is the amount of water available for further licensing. The department assesses the amount of water available by developing an allocation limit, which indicates how much water in total can be abstracted. We then consider how much water is already allocated, and how much water is taken for authorised unlicensed use, as shown in Figure 5. Authorised unlicensed use is water that does not require a licence under the *Rights in Water and Irrigation Act 1914,* and includes water for basic rights such as water taken for stock and domestic purposes.

The water available status for each of the Upper Collie surface water subareas at the time this plan was written (1 March 2009) is summarised in Table 2.

Subareas where the total licensed entitlements equal the allocation limit are fully allocated. This means that there is no further water available.

Subareas where the total licensed entitlements are below the allocation limit have water available.

Subareas where the total licensed entitlement is above the allocation limit are over-allocated. This means that there is no water available, unused licences will be recouped and current licences will be reduced in line with the allocation limit.

Water available (GL/yr) = Allocation limit (GL/yr) – Total licensed entitlements (GL/yr) – Unlicensed use (GL/yr)

Figure 5
Available water equation

Table 2
Surface water allocation limits and water availability in the Upper Collie

Subarea	Resource	Allocation limit GL/yr	Current licensed entitlement GL/yr	Estimated unlicensed use GL/yr	Total allocated GL/yr	Water available
Collie River Central	Wellington Reservoir	85.10	68.00	0	68.00	Water available 1
	Mungalup Reservoir	0.50	0.50	0	0.50	No water available
	Collie River mainstream	1.00	0.52	0.06	0.58	Water available
Harris River	Harris Reservoir	15.00	15.00	0	15.00	No water available
Lower Harris	Lower Harris	1.22	0.01	> 0.01	0.02	Water available
Collie River East Branch	Collie River East Branch	14.00	3.00	0.25	3.25	No water available 2
Collie River Lower East Branch	Collie River Lower East Branch	1.00	0	0.04	0.04	Water available
Bingham River	Bingham River	0	0	0.01	0.01	No water available
Collie River South Branch	Collie River South Branch	5.02	3.20	0.02	3.22	Water available
Total		122.84	90.23	0.38	90.62	

1 At the time of writing this plan (1 March 2009) there were also a number of applications in various stages of assessment. These have not been included in determining water availability.

2 The Collie River East Branch diversion project requires a diversion of up to 14 GL GL/yr. This water is not available for consumptive use.

The water available figures are current as at 1 March 2009. Any subsequent licences will reduce the amount of water available. Please contact the Department of Water for an update on water available for further licensing.

Methodology used to determine allocation limits

The amount of surface water available in each of the seven subareas was determined using modelled daily flows, information on current and potential demands, water quality data, catchment management objectives and information on ecologically sustainable yields.

Detailed reservoir modelling and water balance assessments were completed for the Collie River Central and Harris River subareas containing the Wellington and Harris reservoirs.

For further information on how the allocation limits were determined please refer to *Upper Collie surface and groundwater allocation limits: methods and calculations* (Department of Water 2008), which is available on our website.

Climatic period

The rainfall period we used to set allocation limits for each subarea was from 1975 to 2003, except for the Collie River Central subarea (Wellington Reservoir) which was based on the 1975 to 1999 period. The last decade reflects a drier rainfall period. This may affect the reliability of yields under current limits, which are based on data up to 2003 only.

Ecologically sustainable yields

The ecologically sustainable yield, in the context of available surface water, is the amount of water that is available for consumptive use after the ecological water needs are met. For this plan, we assessed this by subtracting the mean annual ecological water requirement from the mean annual flow of each subarea, as shown in Figure 6.

Water-dependent values and their water requirements have been identified in a number of studies, which are summarised in Table 3. For further information on the ecological water requirements for each of the subareas, refer to the final report referred to in Table 3.

Water licensing and use implications

- Additional monitoring of ecological water requirements to improve certainty is not yet complete. For this reason, in subareas where there is a low demand for water (Lower East and South Branch), allocation limits were set below the estimated ecologically sustainable yield. This ensures we manage the system at a low level of risk from over-abstraction.

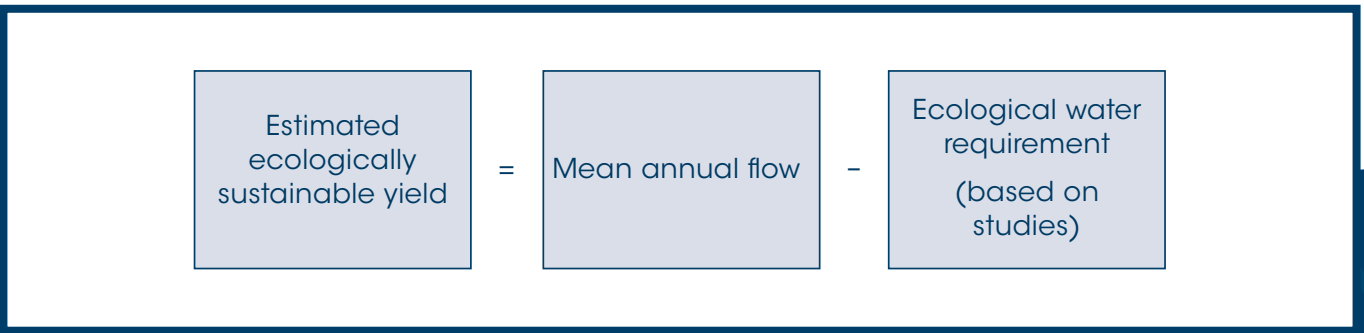


Figure 6
Ecologically sustainable yield equation

Table 3
Upper Collie ecological water requirement studies

Subarea	Study name	Study date
Collie River central (including Wellington Reservoir)	*Lower Collie river ecological water requirements review: stream morphology, riparian vegetation and fish passage*. Water and Rivers Commission.	2003
Harris River	*Harris River East Branch of the Collie River (downstream of the confluence) to the South Branch*. Prepared for Water Corporation by Welker Environmental Consultancy and Streamtec.	2000
Lower Harris	*Harris River East Branch of the Collie River (downstream of the confluence) to the South Branch*. Prepared for Water Corporation by Welker Environmental Consultancy and Streamtec.	2000
Collie River East Branch	*Preliminary ecological water requirements of the Collie River East Branch: risk assessment of salinity mitigation diversion scenarios*. Currently in preparation by Wetland Research and Management group.	2007
Lower East	*Preliminary ecological water requirements of the Collie River East Branch: risk assessment of salinity mitigation diversion scenarios*. Currently in preparation by Wetland Research and Management group.	2007
Bingham River	*Preliminary ecological water requirements of the Collie River East Branch: risk assessment of salinity mitigation diversion scenarios*. Currently in preparation by Wetland Research and Management group.	2007
Collie River South Branch	*Environmental water provisions South Branch of the Collie River downstream from Western 5 open cut*. Welker and Streamtec consultancy.	2001

- We set the allocation limit for the East Branch subarea at 100 per cent of the ecologically sustainable yield. This will allow for the planned diversion of salty surface water flows at Buckingham. During diversion, flow will be reduced downstream of the diversion site. However, the benefits of improved water quality far outweigh the risks of reduced flows to the river ecology.
- The Bingham River subarea provides a valuable input of freshwater to the Upper Collie catchment. This fresh water input improves the water quality and is crucial for the protection of ecological values.
- All flow from the Bingham subarea has been set aside for the environment and the department has set an allocation limit of 0 GL/yr for licensed use. The only current water use within the Bingham subarea is stock and domestic use.
- The Lower Harris subarea also provides a valuable input of fresh water to the Upper Collie catchment. As there is some commercial demand for water within this subarea, we set the allocation limit below the estimated ecologically sustainable yield but above current demand to allow for some growth.

Table 4 provides a summary of the considerations and limits used in allocating the available surface water.

Table 4
Summary of surface water allocation limit assessment

Subarea	Type	Salinity status	Current demand	Management outcome	Allocation limit GL/yr*	Annual reliability %	Method
Collie River Central (including Wellington Reservoir)	Combined (reservoirs and self-supply)	Marginal/ brackish	High	Optimised water use through allocation of water for irrigation and industry	86.60	< 85	Detailed reservoir modelling
Harris River	Reservoir only	Fresh	High	Optimised water use through allocation of water for public water supplies	15.00	83	Detailed reservoir modelling
Lower Harris	Private self-supply	Fresh/ marginal	Med	Maintain freshwater inflows and ecosystem health	1.22	98	30% of ecologically sustainable yield
Collie River East Branch	Private self-supply	Moderately saline	High	Improve water quality through saline stream diversion	14.00	81	100% of ecologically sustainable yield
Lower East Branch	Private self-supply	Brackish	Low	Water is available within the ecologically sustainable yield	1.00	100	< 5% of the ecologically sustainable yield
Bingham River	Private self-supply	Fresh	Low	Maintain freshwater inflows and ecosystem health	0	N/A	0% of the ecologically sustainable yield
Collie River South Branch	Private self-supply	Marginal	Low	Water is available within the ecologically sustainable yield	5.02	91	30% of ecologically sustainable yield

* Based on best available information. The allocation limit may be adjusted based on further studies, additional ecological modelling, or the results of biological monitoring.

1.10 Groundwater use and availability

Current groundwater use

Groundwater from the Cardiff subarea is mainly abstracted for power station water supply. Water is also abstracted for the supplementation of river pools and a small amount is abstracted for private irrigation and unlicensed domestic needs. There are a number of properties within the Cardiff and Premier subareas that do not have access to scheme water and depend on groundwater for domestic purposes.

All licensed abstraction is from the confined Muja and Lower Collie Group aquifers.

In the Premier subarea groundwater is mainly abstracted for coal mining below the watertable and the need to dewater mine pits for safe mining. Groundwater is also abstracted for power station water supply.

The department estimates that 0.15 GL/yr and 0.03 GL/yr are abstracted from the Cardiff and Premier subareas respectively for general stock and domestic purposes (Table 5). These are estimates only and have been calculated based on the number of properties that depend on groundwater (which is 100 properties in Cardiff and 20 in Premier), multiplied by the standard stock and domestic entitlement of 1500 kL/yr.

Within the Cardiff subarea it is difficult to ascertain which aquifer the stock and domestic bores draw water from. Based on the depths to each aquifer, it is likely that shallow domestic bores draw from both the Muja and Lower Collie Group aquifers within the Cardiff subarea and from the Lower Collie Group only in the Premier subarea.

Dewatering activity

There is 49 GL/yr licensed for dewatering purposes in the Premier subarea (Table 5). With an allocation limit (based on annual recharge) of 2.2 GL/yr this means the Premier subarea's licence total is over 2000% of the allocation limit. This indicates that dewatering activity in the Premier is highly unsustainable abstraction.

The Department of Water will not allow any consumptive groundwater abstractions in the Premier above the 2.2 GL allocation limit. This will ensure that, as in the Cardiff subarea, groundwater levels in the Premier will begin to recover once dewatering ceases.

Future groundwater use

Due to the need to recover the groundwater levels of the Cardiff subarea, there is no water available for commercial purposes (Table 5). However the department expects that mine dewatering will increase. Further details on how the department will manage surplus mine dewater is provided in Section 1.11.

Allocation limits and available water

Cardiff subarea

The total allocation limit for the Cardiff subarea is 4.3 GL/yr. The distribution of this amount across each aquifer resource is shown in Table 5 along with the available water status.

The Cardiff subarea is currently over-allocated. No more water is available for allocation. As current licences expire, the department will reduce allocations upon licence renewal.

Premier subarea

The total allocation limit for the Premier subarea is 2.2 GL/yr. The distribution of this amount across each aquifer resource is shown in Table 5 along with the amount of water currently available.

The Premier subarea is fully allocated. No more water is available for allocation from the Premier subarea. Water allocated for consumptive use cannot exceed the respective allocation limits. Water may be allocated above the allocation limit for mine site dewatering only. All other consumptive uses within the Premier subarea will be allocated within the allocation limit.

Table 5
Groundwater allocation limits and water available in the Collie groundwater area

Subarea	Aquifer resource	Allocation limit (GL/yr)	Current licensed entitlements (GL/yr)	Estimated stock and domestic use (GL/yr)	Total allocated (GL/yr)	Water available	Mine dewatering entitlements (GL/yr)
Cardiff	Nakina	0	0	0	0	No water available	0
	Muja	1.79	2.61	0.08	2.69	No water available	0
	Lower Collie	2.51	6.43	0.08	6.51	No water available	0
	Stockton	0	0	0	0	No water available	0
Total		**4.30**	**9.04**	**0.16**	**9.20**		
Premier	Nakina	0	0	0	0	No water available	0
	Muja	0	0	0	0	No water available	0
	Lower Collie	2.20	4.40	0.03	4.43	No water available	49
	Stockton	0	0	0	0	No water available	0
Total		**2.20**	**4.40**	**0.03**	**4.43**		

The figures for water available are current as at 1 March 2009. Any subsequent licences will reduce the amount of water available. Please contact the Department of Water for an update on water available for further licensing.

The allocation limit of an aquifer resource may change in the future. Monitoring water levels and water quality trends over time may provide more detail on how the resource performs and changes over time. Refining the allocation limits may be necessary if new or different trends are found.

Table 6 shows a summary of groundwater allocation limits and management objectives.

Table 6
Summary of groundwater allocation limits and management objectives

Subarea	Current demand	Management outcome	Allocation limit GL/yr	Groundwater storage	Impacts on groundwater-dependent ecosystems	Security of supply for users
Cardiff	High	Maximise recovery of groundwater level	4.30	Recovering to natural level	Pool water levels will continue to recover	Yes
Premier	High	Allocate within net recharge (except mining companies for mine dewatering)	2.20	Declining (from dewatering)	Pool water levels will decline	No

Methodology used to determine allocation limits

We set groundwater allocation limits by considering the hydrogeology of the area, gross and net recharge, current and future water demands, scenario modelling and management objectives.

Collie Coal Basin model

The Department of Water developed a water balance and groundwater model of the Collie Coal Basin in 1999. The model and its components are documented in the *Groundwater Model of the Collie Basin, Western Australia, Report Hydrogeological record 15* (Zhang et al 2007).

Scenario modelling

The Collie Coal Basin groundwater model was used as a predictive tool to determine how groundwater storage and levels would respond to pumping over the long term (50 years). Figure 7 shows how groundwater storage within the Cardiff subarea would respond over time for three scenarios – no abstraction, current entitlements and current allocation limit. The allocation limit represents average actual use from 2000 to 2006 (4.3 GL/yr).

We applied a 10 per cent reduction in recharge to the groundwater modelling scenarios, to account for reduced rainfall, between 1999 and 2007. The influence of abstraction from the Premier subarea on the Cardiff subarea groundwater storage was also considered.

Water licensing and use implications

- The allocation limit for the Cardiff subarea is based on the need to recover the resource. This can only be achieved by increasing the amount of groundwater in storage and ensuring groundwater use is below the amount of recharge entering the system.
- Restoring groundwater levels in the Cardiff subarea will help to meet the water quality and quantity needs for current users. Without groundwater recovery, the quality and availability of water resources will decline in the future.
- The department has set the allocation limit for the Premier subarea at current use (2.2 GL/yr). This limit ensures that the system is not permanently over-allocated for consumptive use. When the need for mine dewatering ceases the groundwater system can begin to recover.
- When dewatering operations cease, the allocation associated with the dewatering licence will not be available for consumptive use. The licensed entitlement will be returned to the department. The previously allocated dewater will then provide recharge to the aquifer.
- Stock and domestic bores abstracting from the confined aquifers will be licensed. Where there is no access to scheme water, the Department of Water will not refuse any licences for stock and domestic purposes.

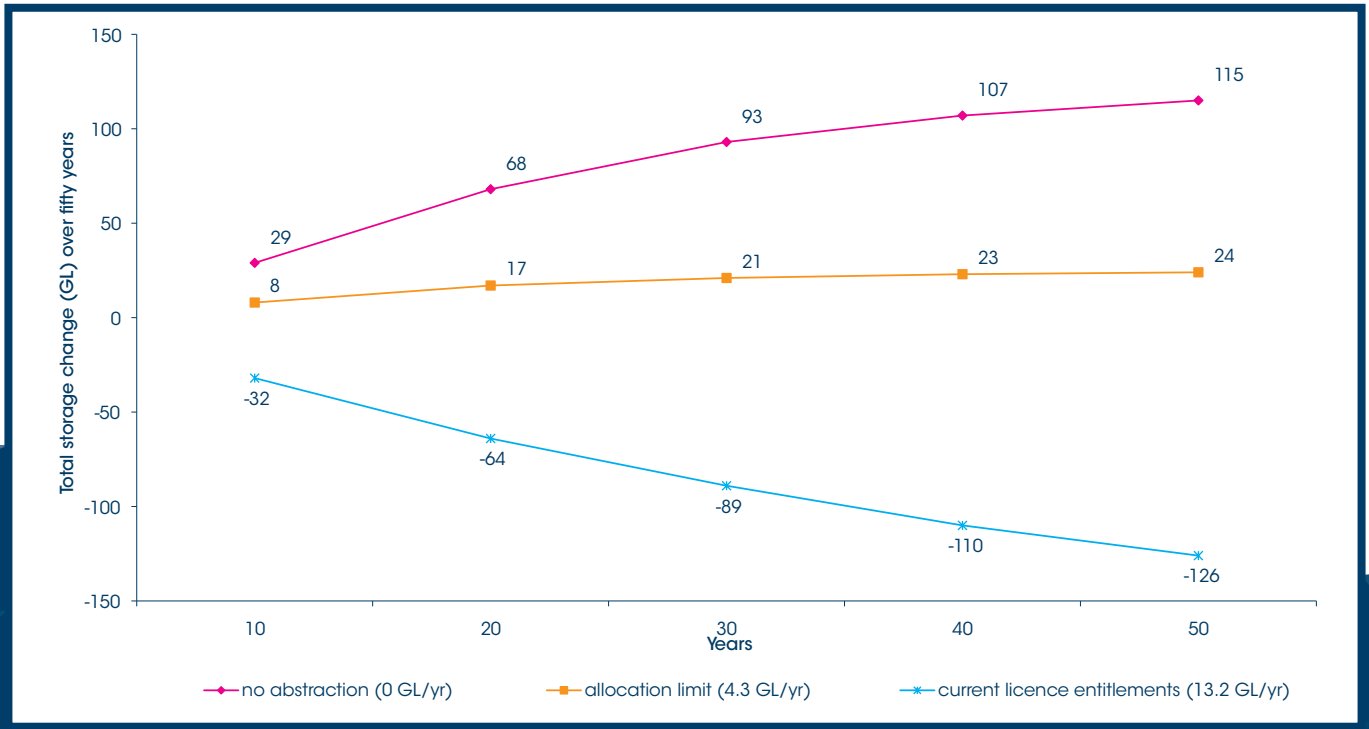


Figure 7
Cardiff subarea predicted groundwater storage change over 50 years

1.11 Mine dewater use and availability

A large volume of mine dewater has been and will continue to be abstracted during coal mining activities in the Collie Coal Basin.

The state government has committed to coal mining under the Griffin Coal and Wesfarmers Premier Coal state agreement Acts. The department has issued each of the mining companies a licence to abstract enough groundwater (mine dewater) from their mining operations to facilitate a safe mining environment.

There is currently a total of 49 GL/yr allocated for mine dewatering.

Mine dewater is mostly a fresh quality resource, but can also be lower quality depending on the aquifer from which it is abstracted.

Water licensing and use implications

- Licensees should only abstract enough groundwater to facilitate safe and efficient coal mining and exploration activities, even if their annual water entitlement is for a larger volume.

Current use of mine dewater

Currently mine dewater is used:

- on site by the mining companies for mining requirements such as dust suppression, processing and machine wash down
- by the mining companies for environmental mitigation purposes, this includes supplementing affected river pools
- by Verve Energy for cooling water in its existing Muja and Collie A power stations
- by Griffin Power for use in the Bluewaters 1 power station.

The largest user of mine dewater in previous years has been Verve Energy. On average, over the past seven years, Verve Energy has used approximately 10 GL of mine dewater to supply its power stations – Muja and Collie A. Significant infrastructure, such as pipes, pumps and the Shotts transfer station, is in place to allow this.

Surplus dewater in excess of mining, environmental, Verve Energy and Griffin Power's requirements has been discharged to the environment.

Water licensing and use implications

The following are the department's preferences for use and/or release of dewatering water and are ranked from highest to lowest:

1. efficient on-site use
2. providing environmental water to mitigate impacts
3. transferred to meet other demand
4. injection back into the aquifer, where hydrogeologically appropriate and agreed by the department
5. controlled release to the environment.

Future use of mine dewater

There is an immediate demand for dewater as a water supply source for third parties other than Verve Energy and Griffin Power's Bluewaters 1 power station. These parties include Griffin Power 2's Bluewaters 2 power station and the proposed Perdaman Industries Collie urea project. In addition to these proposals there are a number of pending proposals including Griffin Power's Bluewaters 3 and 4 power stations. Subject to supply and infrastructure constraints, there may also be scope for the Water Corporation to take surplus dewater for public water supplies.

The department is limited in its legislative power to reallocate dewater to third parties under the *Rights in Water and Irrigation Act 1914.* Provisions for supplying dewater to the state, and potentially private third parties, currently do (and could continue to) exist under each of the mining companies' state agreements, which are governed by the Department of State Development. Use of dewater by Verve Energy features as a priority on both of the coal mining state agreements

Currently, Wesfarmers Premier Coal's state agreement allows for the supply of surplus dewater to private third parties however, there are no provisions under Griffin Coal's state agreement to supply to private third parties.

To date power companies seeking to secure a portion of surplus mine dewater from Griffin Coal have obtained it under exceptional circumstance through other mechanisms.

In 2005, Griffin Power was assigned 3.25 GL/yr for its Bluewaters 1 power station by the minister responsible for the company's state agreement.

In 2008, Griffin Power 2 secured a one-off RiWI s.5C licence from the department to abstract 3.25 GL/yr for dewatering purposes (only) from Griffin Coal's mine site to provide water to its Bluewaters 2 power station. To allow for this the department reduced Griffin Coal's mine dewatering licensed volume from 30 to 26.75 GL/yr.

Water licensing and use implications

- To optimise the use of existing resources the department strongly supports the use of surplus mine dewater by third parties.
- The Department of Water does not currently have legal provisions to allocate surplus dewater to a third party. Third parties seeking a share of dewater must enter into a water supply agreement within the provisions of the Wesfarmers Premier Coal's state agreement. Griffin Coal's state agreement would need to be amended to allow for supply to private third parties.

  To be supported by the department any water supply agreement must be consistent with this plan.
- The department acknowledges the following priorities for sharing surplus dewater under Griffin Coal's state agreement.

a Griffin Power for the Bluewaters 1 power station

b Verve Energy for the Muja and Collie A power stations

c state needs and other private third parties

> **Note:** Griffin Power 2 does not have a priority for the supply of dewater to its Bluewaters 2 power station from Griffin Coal's state agreement. The company instead has an s.5C licence to abstract groundwater for dewatering purposes from Griffin Coal's mine site.

The department currently acknowledges the following priority for sharing surplus dewater under Wesfarmers Premier Coal's state agreement:

a Verve Energy for the Muja and Collie A power stations

b state needs and other private third parties

- Proposed new power stations, industries and public water suppliers are encouraged to use surplus dewater when available, recognising that this is subject to availability and is therefore at a lower level of reliability than for current approved power stations.
- All third-party agreements for use of dewater become redundant once the requirement to dewater ceases.
- The department recommends that the Minister for Water be consulted about any supply of surplus dewater to third parties before decisions are made under state agreement.

- The department recommends the Department of State Development review the mining state agreements to reflect the current demand and supply context of dewater to non-state third parties, and to ensure they are consistent with the contemporary management arrangements set in this plan.
- Once surplus mine dewater is released into a wetland, watercourse or underground water source, it is subject to the *Rights in Water and Irrigation Act 1914* and could be allocated or re-allocated through a s.5C licence.

Potential supply of mine dewater

It is difficult to estimate the volumes of dewater that will be available in the future on an annual basis, and even more so for the monthly and daily projections that current and proposed users of dewater rely on. This is due to a number of factors such as the complex hydrogeology of mine sites, the limitations of modelling, evolving mine plans and operational changes resulting in variations from the dewater design. Historically, annual dewatering schedules provided to the department have been conservative, overestimating projected dewater volumes.

Analysis of projected versus actual annual abstraction over the last twenty years indicates that, on average, accuracy ranged from 63% to 92%.

Figure 8 shows the total volume of dewater projected against the demand of currently approved activities, which includes:

- mine-site requirements
- water required for mitigating environmental impacts
- actual demand of approved power stations (Muja, Collie, Bluewaters 1 and Bluewaters 2).

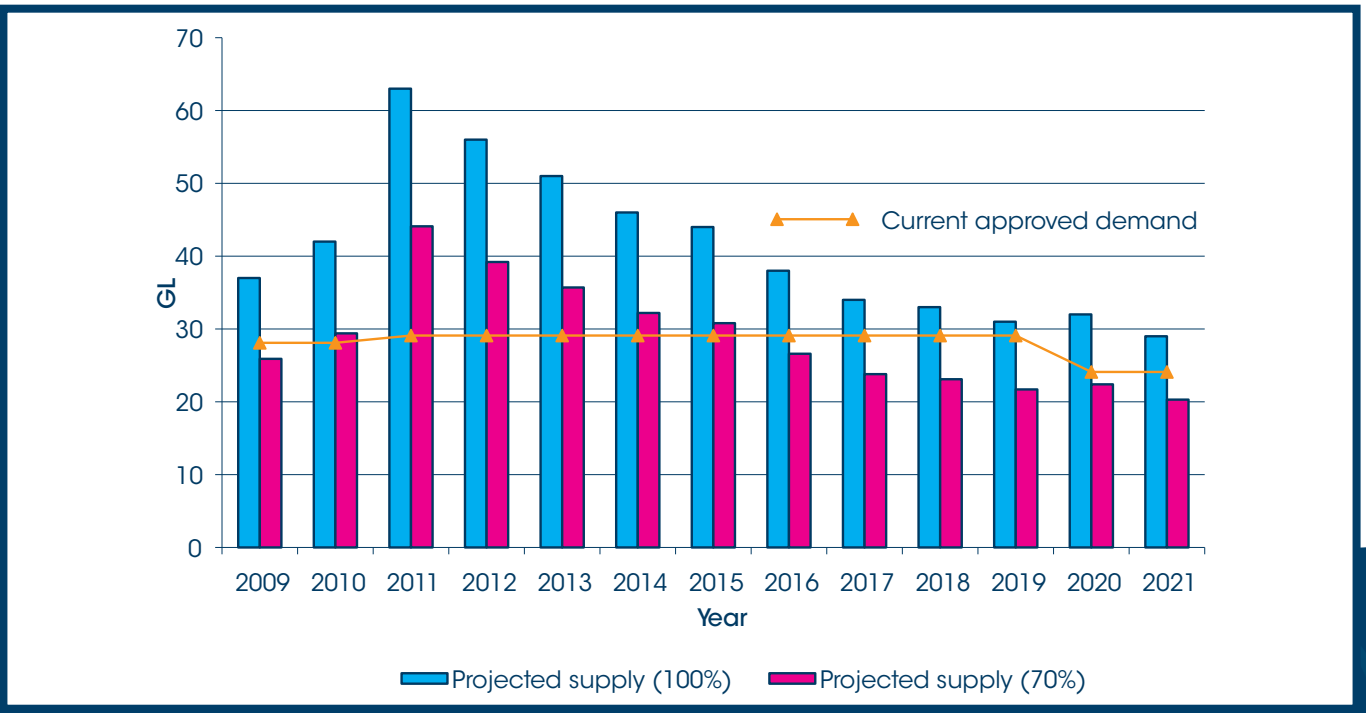


Figure 8
Projected annual mine dewater supply and current demand by approved power stations

It shows that there may be enough water available to satisfy these needs until 2021 if actual dewatering volumes match what has been projected. It also shows that if dewatering projections are only 70% accurate there will be a supply shortfall in 2009 and then again in 2016 to 2021. While the actual availability will fall within this range, working to 70% reliability provides a higher level of security for power supply.

Water licensing and use implications

- The amount of mine dewater potentially available in the future may vary from predictions, therefore water users should take a risk-based approach when estimating future dewater availability.
- Water users should not rely on mine dewater as the only water source by any industry. They will need contingency water supplies.
- The supply of dewater is unreliable and may be limited or not available at all during peak summer demand periods.
- If the volume of water abstracted to facilitate safe and efficient coal mining and exploration activities on any one day is insufficient to meet third party demand, the department will not permit additional abstraction to make up this shortfall.
- All dewatering licences expire once the need to dewater for safe mining practices ceases, irrespective of the end use of the dewatering discharge.
- The department encourages the use of available technologies to reduce or remove the need for water, particularly high quality water, in industrial processing or cooling operations.

1.12 A Collie Water utility

Given the state government's vision for water resource improvement in the Upper Collie, there is scope to develop an integrated water supply utility, which would have entitlements to dewater from the Collie Coal Basin for redistribution. Since 2007 the department has been developing the concept of a 'Collie Water utility'.

A water utility would receive and distribute all water sourced from within the Upper Collie catchment and provide equity between competing users by managing water supply and access through a central, integrated, coordinated market mechanism.

The responsibilities of the water utility would be as follows:

- Build, or assume ownership of, and maintain the infrastructure (such as pipes and pumps) required to access, distribute and sell water to local and regional industry.
- Maintain and operate a fair, equitable and transparent market mechanism to sell water to local and regional industry.
- Administer its allocation or assignment of dewatering water and surface water to preserve the consumptive pool defined over the long term.
- Ensure that the highest use of water is achieved.

A water utility would enable industry and energy operators to secure their water through a water service provider rather than have individual agreements made with mining companies, who are dewatering only for the purpose of safe mining of coal.

Feasibility of a water utility to improve equity of access and security of supply will be considered through a forthcoming independent review. In the meantime, water users must consider options to make use of water from Wellington Reservoir as a fit-for-purpose source, along with options to use no-water technologies. Any future diversion and desalination project will make more high quality water available in the Upper Collie, and will provide scope to save water through increased efficiency in the Collie River Irrigation Area.

Part two

Upper Collie water allocation plan

Chaptertwo

Upper Collie water allocation plan

2.1 Objectives

The objectives of this plan are:

- to increase accountability for water use and its associated impacts
- to limit abstraction of water up to or equal to the allocation limit for a resource (other than mine dewatering that has approval under a state agreement)
- to recover over-allocated water resources to sustainable levels
- to protect existing ecological, social and cultural values
- to protect the security of supply for water users
- to ensure that water is used in the most efficient way
- to achieve the highest value use of water resources
- to minimise water quality impacts of abstraction and use and where possible increase the quality of the water resources.

2.2 Strategies

The strategies of this plan are to:

- allocate within annual allocation limits for each of the resources
- implement the water licensing policies
- uphold the plan's positions
- undertake plan actions.

2.3 Positions

Department positions are statements on how we should complete an activity. Positions are non-binding under the *Rights in Water and Irrigation Act 1914* but reflect an agreed strategic direction within the department, and should be supported by stakeholders and decision-making authorities.

To address the water allocation issues and reach the allocation objectives of this plan the following positions will be upheld by the department:

- This plan provides the department's position and policies on allocating water from the Upper Collie catchment and supersedes previous water allocation principles established by the Collie Water Advisory Group 1999.
- The highest value use of the water resources will be achieved by:
  - allocating the freshwater resource of the Harris Reservoir to public water supplies

- allocating the marginal water resource of the Wellington Reservoir to irrigation, regional industries and, potentially, public water supply
- allocating the groundwater resources of the Cardiff subarea for contingency water supply for current power stations and to provide environmental water
- accounting for the use of mine dewater from the Premier subarea for mining, environmental water and current approved power stations.

- Mine dewater is a valuable, often high quality, but relatively unreliable resource.
- To optimise the use of existing resources the department strongly supports the use of surplus mine dewater by third parties.
- The amount of mine dewater potentially available in the future may vary from predictions, therefore water users should take a risk-based approach when estimating future dewater availability.
- Water users should not rely on mine dewater as the only water source by any industry. They will need contingency water supplies.
- The department currently acknowledges the following priorities for sharing surplus dewater under Griffin Coal's state agreement:

a Griffin Power for the Bluewater 1 power station

b Verve Energy for the Muja and Collie A power stations

c state needs and other private third parties

- The department currently acknowledges the following priorities for sharing surplus dewater under Wesfarmers Premier Coal's state agreement:

a Verve Energy for the Muja and Collie A power station

b State needs and other private third parties

- Proposed new power stations, industries and public water suppliers are encouraged to utilise surplus dewater when available, recognising that this is subject to availability and is therefore at a lower level of reliability to current approved power stations.
- The Department of Water does not currently have legal provisions to allocate surplus dewater to a third party. Third parties seeking a share of dewater must enter into a water supply agreement within the provisions of the Wesfarmers Premier Coal's state agreement. Griffin Coal's state agreement would need to be amended to allow for supply to private third parties. To be supported by the department any water supply agreement must be consistent with this plan.
- The Minister for Water should be consulted about any supply of surplus dewater to third parties before decisions are made under the state agreement.
- The department encourages the use of the Wellington Reservoir for fit for purpose supply.
- The department encourages use of available technologies to reduce or remove the need for water, particularly high quality water, in industrial processing or cooling operations.

- Government approvals (i.e Environmental Protection Authority) for proposals to use surplus mine dewater (that is, water that is not taken under a s.5C licence to abstract) should require conservation measures commensurate with the Department of Water's *Statewide policy no. 16 – Water conservation and efficiency plans.*
- Once surplus mine dewater is released into a wetland, watercourse or underground water source, it is subject to the *Rights in Water and Irrigation Act 1914* and could be allocated or re-allocated by the department through a s.5C licence.

2.4 Allocation limits

The department will manage to the annual allocation limits presented for surface water in Table 1 and groundwater in Table 2. Information on how the allocation limits were set is provided as background in Part 1, Sections 1.9 and 1.10.

Table 8
Groundwater allocation limits

Subarea	Resource	Allocation limit GL/yr
Cardiff	Nakina	0
	Muja	1.79
	Lower Collie Group	2.51
	Stockton	0
Premier	Nakina	0
	Muja	0
	Lower Collie Group	2.2
	Stockton	0

Table 7
Surface water allocation limits

Subarea	Resource	Allocation limit GL/yr
Collie River Central	Wellington Reservoir	85.10
	Mungalup Reservoir	0.50
	Collie River Mainstream	1.00
Harris River	Harris Reservoir	15
Lower Harris	Lower Harris	1.22
Collie River East Branch	Collie River East Branch	14.00
Collie River Lower East Branch	Collie River Lower East Branch	1.00
Bingham River	Bingham River	0
Collie River South Branch	Collie River South Branch	5.02

2.5 Policies for water allocation and use

To address allocation issues, manage impacts of water use and reach allocation objectives of this plan, the following policies will be implemented by the department.

Policies are the department's formal statements on how a decision will be made or how a process will be carried out.

Table 9
Water allocation and use policies

Policy group		Policy detail
1	Mine dewatering and dewatering discharge	
1.1	Managing dewatering operations	A dewatering management plan must be submitted to the department as part of a new licence application for dewatering or, for existing licensees, in the next annual report submitted. The dewatering management plan should include how the licensee manages: • the release and disposal of dewater to the environment (as per policy 1.2) • impacts associated with dewatering (including supplementation) (as per policy 1.7) • monitoring (such as volume, location, frequency, duration) and mitigation measures associated with dewatering operations (as per policy 1.6) • third party reuse of dewater • mine void closure (as per policy 2.1) For new licences the dewatering management plan will form part of the requirements for the operating strategy and will inform the development of licence conditions. For existing licences the information submitted in the dewatering management plan will be used to review the operating strategy and licence conditions.
1.2	Release options for dewater	**1.2.1** The department will licence and set conditions to manage the disposal of all dewatering water to the environment under the groundwater licence. Prior to having a licence issued, the applicant must define the end use or disposal of dewater in a dewatering management plan (see policy 1.1). The following are the department's preferences for use and/or release of dewatering water and are ranked from highest to lowest: 1 efficient on-site use 2 providing environmental water to mitigate impacts 3 transferred to meet other demand a existing approved power stations b state needs and other proposed industries 4 injection back into the aquifer, where hydrogeologically appropriate and agreed by the department 5 controlled release to the environment where the dewater discharge is allowed to flow (either through a pipe or overland) into a designated drain, water course or wetland determined by the proponent.
		1.2.2 If it is demonstrated that dewatering discharge cannot be used (as per the above priorities 1 to 4 in policy 1.2.1) the department will negotiate the release of dewatering discharge on a site-by-site basis. Negotiations will recognise background water levels (quality and quantity) of the receiving environment and any relevant water quality guidelines (including the Australian and New Zealand Environmental Conservation Council). The method of disposal shall be managed by the licensee in consultation with the department.
		1.2.3 Proponents undertaking dewatering will not be permitted to dispose of dewater into the environment where the predicted impacts are unacceptable.

Table 9
Water allocation and use policies

Policy group		Policy detail	
1.3	Use of dewater by third parties	1.3.1	Licensees are currently not able to sell any volume of water abstracted as part of their dewatering operations, as per each mining state agreement.
		1.3.2	All third-party agreements for use of dewater become redundant once the requirement to dewater ceases.
1.4	Mine safety and dewatering	Notwithstanding the annual water entitlement referred to in any dewatering licence, the licensee shall only take groundwater to meet the requirements for safe and efficient coal mining and exploration activities. The department will not permit additional abstraction in these cases to meet third party demands.	
1.5	Cessation of dewatering licence	All dewatering licences expire once the need to dewater for safe mining practices ceases, irrespective of the end use of the dewatering water.	
1.6	Monitoring and reporting requirements for dewatering	1.6.1	Abstraction associated with dewatering will drawdown the natural groundwater levels at a local and regional scale. Licensees must appropriately manage impacts associated with groundwater water level decline and altered water quality (increases in salinity and acidity) (as per policy group 5.2).
		1.6.2	Information submitted to the department by the licensee as part of the reporting requirements associated with a water licence will be used to measure compliance with licence conditions and to assess the performance of the plan.
		1.6.3	Licensees undertaking dewatering activities are required to measure volumes (daily) and report (monthly and/or annually) on abstraction, use and supply as a minimum standard. They may need to demonstrate that dewater is being used efficiently.
1.7	Impacts from dewatering	1.7.1	Licensees must immediately report to the department impacts on water quality, water levels or other users (including the environment) identified through monitoring that were not anticipated in the operating strategy or dewatering management plan. The department will advise the licensee on the appropriate response, which may be to investigate and remediate impacts. In serious instances the department may direct that the licensee reduce or stop the dewatering (pumping) operation until they address the impacts.
		1.7.2	In addition to the requirements of *Statewide policy no. 19 – Hydrogeological reporting associated with a groundwater well licence* the department may require the proponent to undertake hydrogeological and/or hydrological modelling for all dewatering proposals to determine the extent of the predicted impacts.
		1.7.3	For significant dewatering operations (> 6 months duration, > 500 000 kL/yr), the licensee must monitor groundwater levels and quality on a monthly basis to determine dewatering impacts on the aquifer and associated connected systems. This is a minimum requirement and may be increased depending on the level of risk.

Table 9
Water allocation and use policies

Policy group		Policy detail	
2	Mine void management		
2.1	Mine voids	2.1.1	Once mining operations cease, the closure, use and ongoing management of mine voids must not have an undue impact on the environment or the connected surface water and groundwater interactions. To minimise the impact of mining on the quantity and quality of water resources, proponents must specify how the water will be managed and likely water related impacts in the dewatering management plan.
		2.1.2	The department may license the use of water in the management and remediation of mine sites and mine voids. Where a licence is required, the department will apply licence conditions regarding the diversion, dewatering, monitoring and management of water. This may include the volume, frequency, pump rate, diversion location, water levels, and water quality of the water use. The operating strategy for the licence will include triggers and responses for each of these conditions.
		2.1.3	The department may license the use of mine voids to store or transfer water (other than dewater). In cases where mine voids are used to store poor quality water (including water of < pH 4 acidity and > 1000 mg/L total dissolved salts), the department expects proponents to include provisions for monitoring and mitigating impacts in the dewatering management plan. The licensee must also include the storage duration and options analysis to remove the water. The department will only issue licences once there is certainty that the stored water will not adversely affect the quality or availability of existing water within the locality of the void.
2.2	Use of mine void water	Within the plan area the department considers mine voids that have re-filled (or partially re-filled) with water (surface water or groundwater) to be part of the groundwater resources. The department may license all use, storage and transfer of water from mine voids in the future, depending on the particular mine void.	
3	Allocating water		
3.1	Wellington Reservoir	Applicants for water from the Wellington Reservoir must have legal access before the department can assess an application, and will need to negotiate a bulk water supply agreement with the Water Corporation. The department will consider alternative mechanisms, to be advised publicly, for releasing this water.	
3.2	Security of supply	Licensees must achieve security of supply through diversity of sources and implementation of adaptive management when supply becomes limited. Major licence holders (> 500 000 kL/yr) must manage their security of supply through new or contingency source planning, design technology and water use efficiency.	
3.3	Reaching the allocation limit	When the total licensed entitlements for a given groundwater resource and subarea reaches the allocation limit, the department will refuse any further applications for new entitlements, other than a trade/transfer or for confirmed dewater.	

Table 9
Water allocation and use policies

Policy group		Policy detail	
4	Water use and supply		
4.1	Efficient water use	Licence applications (or renewals) > 250 000 kL/yr must be accompanied with a water efficiency or conservation plan consistent with *Statewide policy no. 16 – Policy on water conservation/efficiency plans*.	
4.2	Fit for purpose use	**4.2.1**	The department does not endorse the use of high quality water in industrial processing. The department will not approve new licence applications to use high quality water resources for industrial water without a comprehensive assessment of the various water supply options available.
		4.2.2	Where possible, water users should match uses requiring lower quality water with appropriate sources. In areas where high quality water is limited, the department supports alterations to proposals (such as alternative irrigation infrastructure) to access lower quality water such as high nutrient, saline or recycled water.
5	Environmental policies		
5.1	Environmental impact management	**5.1.1**	The department expects proponents to identify water-dependent values as part of their application, as per *Statewide policy no. 19 – Hydrogeological reporting associated with a groundwater well licence* or *Statewide policy no. 5 – Environmental water provisions policy for Western Australia*.
		5.1.2	In cases where impacts from abstraction are expected, applicants and current licensees must: • determine the water requirements of affected water-dependent values • specify how they will manage the impacts • specify an appropriate monitoring program • submit an impact management plan. The monitoring program must be designed to measure impacts on the system and impacts on water values as well as evaluate the success of mitigation measures.
		5.1.3	All groundwater licence applications must comply with relevant environmental legislation as well as the policies contained in this plan.
		5.1.4	If a project requiring water is submitted where the scale or scope means that the department cannot fully considered it under this plan and the *Rights in Water and Irrigation Act 1914*, the department may refer the proposal to the Environmental Protection Authority (EPA) for advice. The department will assess the licence application and incorporate EPA advice where relevant.
		5.1.5	Where the department receives a water licence application for a proposal which requires assessment by the EPA under the *Environmental Protection Act 1986*, the department will use any advice or information which arises from the EPA process to assess the application. Approval for a project by the EPA does not mean that the department will approve a water licence.
		5.1.6	In circumstances where impacts are associated with more than one licensee, the department will negotiate and agree with the licensees on how to share the responsibilities for impact management and associated costs.

Table 9
Water allocation and use policies

Policy group		Policy detail	
5.2	Mitigation measures including pool supplementation	5.2.1	The department will apply *Environmental offsets – position statement no. 9* (EPA 2006) to assess proposals requiring trade-offs or offsets. The licensee will bear any costs associated with recovery of impacts resulting from the abstraction and/or the offsets/trade-off measures.
		5.2.2	Where there is a demonstrated impact from groundwater drawdown, the department may endorse supplementation for maintaining river pools with significant value. Existing mitigation and supplementation of groundwater-fed river pools will continue until groundwater levels have restabilised to baseline levels. Supplementation may need to occur long after mining activities have ceased.
		5.2.3	The department has endorsed supplementation for the following pools in the Collie River: • Cardiff Town Pool (South Branch) • Duderling and Buckingham Bridge/Town Pool (East Branch).
5.3	Acid sulfate soils and acid generating materials	Applicants for a large project must prepare appropriate documentation to support their application in areas of high risk of generating acidic water or soils. This may include an acid sulfate soil management plan. The Department of Water will not grant approval to take water until the Department of Environment and Conservation approves appropriate management arrangements.	
5.4	Contaminated sites	The department will not consider applications to take water from an identified contaminated site unless the relevant authorities (including Department of Environment and Conservation and the Department of Health) approve appropriate management arrangements. For more information on contaminated sites please see: <www.dec.wa.gov.au/pollution-prevention/contaminated-sites/index.html>.	
5.5	Pollution events	Point source pollution of groundwater through industrial or other activities is regulated through the *Environmental Protection Act 1986*. The EPA should be contacted if evidence of a pollution event has been identified.	
6	Water quality		
6.1	Water quality	The department may require a licensee to monitor and report on the quality of their water resource, in particular its salinity and acidity. Water use in the plan area must not increase the background (baseline) levels such that it adversely affects a water system (including other users). This includes activities such as dewatering, excavating, application of nutrients, discharge of waste water, pool supplementation, irrigation or processing with saline water. The department will include requirements to monitor and report as conditions on the licence.	
6.2	Water quality for domestic self-supply	If there is no scheme water available for domestic self-supply, the department supports the use of ground or surface water. However we advise water users to filter, treat and test the water according to public health advice available from the Department of Health, Water Quality Branch. See the department's water quality protection notes on 'community' and 'private' supplies for guidance on such use. The *Australian Drinking Water Guidelines 2004* and *Australian Fresh and Marine Water Quality Guidelines* also provide information on relevant drinking water quality criteria.	

6.3	Salinity	6.3.1	Where a licence application has the potential to increase the baseline salinity of a water resource (such as from an increasing rate of saline river recharge to fresh groundwater), the applicant must assess and define how they will manage the water quality deterioration will in the long term. The department may apply additional licence conditions to manage the water use impacts, protect water quality and protect dependent systems.
		6.3.2	A licensee (other than that abstracting for dewatering purposes) must report any increase to the existing salinity (to the next threshold category in Appendix K) of the water resource they are abstracting from to the department within seven days. The department will provide advice to the licensee and may restrict pumping from this source until the salinity levels return to the baseline conditions. The department may amend licence conditions, increased monitoring, mitigation and remediation.
7	Social and cultural		
7.1	Cultural sites	All applicants must meet any statutory requirements under the state's *Aboriginal Heritage Act 1972* or the Australian Government's *Native Title Act 1993*, where applicable.	
7.2	Drinking water source protection	All licensed activities must be undertaken in accordance with any public drinking water source protection plan implemented by the department for a given water resource.	
8	Public water supply and large industrial projects		
8.1	Source development and water supply strategies	8.1.1	All water users > 1,000 000 kL/yr must complete source development plans or water supply strategy and submit them to the department. The source development plans should identify supply options and how security of supply will be achieved, including water efficiencies and strategies to meet short and long term supply options. A water supply strategy should include (but not be restricted to) strategies that cover: water supply demand for both quality and quantity; waste water streams and treatment; site water balance; prioritised supply strategy; contingency supply options; supply triggers and response; on-site storage management and water use efficiency plans.

8.2	Harris Reservoir	8.2.1	The Water Corporation (as the owner of Harris Reservoir) is permitted by the department to use Harris Reservoir for additional storage of augmented water. Before any water augmentation takes place, the department and the Water Corporation must be satisfied that the additional water will not unacceptably lower the quality of water in Harris Reservoir. It is critical that the water taken from Harris Reservoir is of public drinking water standard.
		8.2.2	The Water Corporation must establish a separate water accounting system to assess the water balance in the reservoir and allow for additional inputs and or abstractions outside the department's allocation and licensing system. This will not alter the allocation limit as outlined in this plan.
		8.2.3	The Harris Reservoir accounting system for augmented water will need to account for any additional inputs (such as dewater or desalination), the amount of water lost through evaporation, seepage and/or spillage and the amount of water banked and available for use. The Water Corporation can then abstract banked water following assessment by the department.
		8.2.4	Any water lost through spillage is subtracted from the total stored, augmented water.
		8.2.5	The department does not consider surface water from Harris Reservoir that is part of the licensed entitlement and is not abstracted within one year, as 'banked' water.
8.3	Future water use	Future water use for sustainable regional growth and development will be satisfied before water is exported out of the region. The area to which the water is being exported must have a deficit of supply, with all other reasonable supply and demand management options implemented to the department's satisfaction.	
9	**Licensee responsibilities**		
9.1	Application requirements	9.1.1	It is the individual licensee's responsibility to provide the department with the requested information, to enable the complete assessment of their licence application. The department will assess any requested information in accordance with *Statewide policy no. 17 – Timely submission of required further information*.
		9.1.2	With the licensee's permission, all information submitted by a licensee on water levels, water chemistry, abstraction (metered use) and hydrogeological work (including any local models) will be used in the department's reporting on resource conditions.
9.2	Renewal of water licences	9.2.1	It is the licence holder's responsibility to make an application to extend the term of the existing licence before the expiry date. The department will treat any licence application submitted after the expiry date as a new licence application.
		9.2.2	In fully allocated areas, licensees must not allow their licences to expire as the department cannot guarantee that the licence will be renewed if the water is not available.
		9.2.3	At renewal, the department may place more stringent conditions on an expired licence in a fully allocated area.

10	General licensing rules and requirements	
10.1	Assessment process	10.1.1 The department will manage the standard licence tenure for new commercial licences in accordance with *Statewide policy no. 9 – Water licensing – staged developments*. Upon meeting the development conditions the licence tenure becomes 10 years unless otherwise stated.
		10.1.2 The licence tenure for public water supply and large industrial developments (> 500 000 kL/yr) will generally be 10 years. Where there is uncertainly and risk associated with the licence the tenure may be changed.
		10.1.3 Where a licence is required in the plan area, the department will assess it as per the *Rights in Water and Irrigation Act 1914*. Exemptions may apply for some water use activities.
10.2	Licence conditions	The department may, at its discretion, include in a licence any terms, conditions or restrictions as stated in Schedule 1, Clause 15 of the *Rights in Water and Irrigation Act 1914*.
10.3	Licence requirements for stock, domestic and garden use	10.3.1 Private domestic water supply requirements in areas with no access to scheme water must be satisfied before water is allocated for private, commercial or public use.
		10.3.2 Abstraction from any confined aquifer, for stock and domestic purposes, requires a licence.
		10.3.3 Irrigation of gardens and lawns associated with a domestic residence is restricted to between the hours of 6 pm and 9 am all year round. Alternate day water restrictions may apply.
		10.3.4 The department considers aquaculture to be stock raised under intensive conditions and is generally not exempt from licensing in the plan area.
		10.3.5 Construction of dams for stock and domestic purposes require a permit to interfere with bed and banks.
		10.3.6 Dams for non-intensive/non-commercial (stock and domestic) purposes will not require a licence to take surface water if they do not exceed a storage capacity of 8000 kL.
10.4	Recouping unused water entitlements	The department may reduce unused portions of licensed entitlements in accordance with *Statewide policy no. 11 – Management of unused water entitlements*.
10.5	Metering	All new groundwater licences > 50 000 kL/yr will be subject to a condition requiring the installation and maintenance of a department approved flow meter (*Rights in water and Irrigation (approved Meters) Order 2009*) for each draw point. Installation must be undertaken in accordance with the *Guidelines for Water Meter Installation 2007*.

10.6	Staged developments	10.6.1	All applications for new developments will be assessed as per *Statewide policy no. 9 – Water licensing – Staged developments*.
		10.6.2	A detailed development plan and timetable stipulating the proposed activity, the area of development and the timeframe for each stage of development must accompany all new or amended licence applications. This must include the completion date where the full licence entitlement usage will be reached.
		10.6.3	The department may amend the licensed entitlement or licence conditions where the licensee does not comply with the staged development conditions associated with a licensed entitlement.
10.7	Operating strategies	10.7.1	Operating strategies will be implemented as per this plan and *Statewide policy no. 10 – Use of operating strategies in the water licensing process*. Operating strategies are applicable to any licensed entitlement where additional monitoring is needed to ensure any adverse impacts from abstraction are identified and managed. This includes dewatering operations.
		10.7.2	The department may require operating strategies to be developed for applications undergoing an assessment under *Statewide policy no. 19 – Hydrogeological reporting associated with a groundwater well licence.*
		10.7.3	The department will develop operating strategies in conjunction with the licensee, with all conditions and requirements in the strategy to be auditable and appropriate for the purpose of the abstraction (see *Statewide policy no. 10 – Use of operating strategies in the water licensing process*). The department will use information submitted in the operating strategy to develop licence conditions and/or additional monitoring or measurement requirements in the operating strategy or as a schedule to the licence.
		10.7.4	The department may decide to amend any licences over 500 000 kL/yr that currently do not have an operating strategy.
11	Self-supply (commercial) groundwater licensing		
11.1	General requirements	11.1.1	The department licenses groundwater abstraction from any aquifer in the plan area as per the *Rights in Water and Irrigation Act 1914*. Exemptions may apply for some water use activities.
		11.1.2	When a new application is received for a new bore, the department will issue the licences in two parts: • issue of a 26D licence for the construction of the bore • issue of a 5C licence only after the department has received a valid borehole log and completion details and the aquifer has been identified. For guidance regarding the construction, cement grouting and abandonment of bores see <www.water.wa.gov.au> Licensing and Industry support > Licensing > Publications.

11.2	Bore construction	11.2.1	Following completion of the bore construction it is the licensee's responsibility to submit a certified driller's borehole construction report, including lithology, surveyed level of bore geophysical log and pump test results before a the department will issue a licence to take (5C) the water.
		11.2.2	The proponent must construct, modify or decommission monitoring and abstraction bores in accordance with *Groundwater monitoring bores, Water quality protection note no. 30* (Department of Water 2006) and *Minimum construction requirements for water bores in Australia* (NMBSC 2003).
		11.2.3	Proponents must not locate new bores within the following distances of ecological or cultural assets such as groundwater-dependent ecosystems, defined river systems with a known surface and groundwater connection or a known groundwater-dependent wetland: • 100 metres for bores used for domestic, stock or garden use (GDE or wetland) • 200 metres for bores used for all other purposes (GDE or wetland) • 50 metres of a river or stream with a known groundwater baseflow. The department may vary these distances following an assessment by the department using *Statewide policy no. 19 – Hydrogeological reporting associated with a groundwater well licence*. This may include increasing or decreasing the distance and volume associated with the licence application to minimise the potential impact on the connected system (decline in dependent aquifer water levels).
		11.2.4	The department can provide advice to the licensee on the time frame, disposal or discharge location for the pump test water for any pump testing that is required in the construction of a production bore. This may include treatment of the pump test discharge water to ensure that there are no impacts associated with its disposal.
		11.2.5	All new licence applications for groundwater that require the construction of a new bore or propose to use an existing bore, must recognise that dewatering activities in the area may affect the water levels, quality and pump rates in that area. All applicants are responsible for drilling to an appropriate depth to ensure the effects likely to result as part of the dewatering are minimised. The department will provide advice, where available, to the applicant on depth and the likely impacts for a given area and aquifer.
11.3	Groundwater investigations	11.3.1	In certain circumstances, proponents of a proposal may be required to submit a hydrogeological report to the department in accordance with *Statewide policy no. 19 – Hydrogeological reporting associated with a groundwater well licence*.
		11.3.2	Information submitted as part of a hydrogeological assessment will be used by the department to assess the possible local and regional impacts of the proposed abstraction on the hydrology, environment (see policy 5.1) and other groundwater users.

11.4	Monitoring bores		The licensee is responsible for monitoring, maintaining and constructing a private monitoring bore. The licensee must submit measurements and metering results annually to the department. Private monitoring bores must be located on land owned by the licensee or land that the licensee has legal access to. The department may provide advice to the licensee on the preferred location of the monitoring bore however this should be considered in the hydrogeological report. The department will define the frequency and duration of the measurement of the static water level readings (m AHD) or water quality parameters in the licence conditions and will review them on an annual basis. The frequency and duration of the monitoring period will reflect the level of impact and risk associated with the licence application assessment.
12	Self-supply (commercial) surface water licensing		
12.1	General requirements	12.1.1	The department will consider the amount of surface water to be used and stored, evaporation, and water required to maintain dam structural integrity when determining the annual water entitlement for a surface water licence.
		12.1.2	All new on-stream dams with the potential to cause unacceptable impacts to downstream users and the environment must have a low-flow bypass system and may also require other controls that allow for the migration of aquatic species. The department may require existing on-stream dams to have a bypass system to control flows, as well as other controls that allow for the migration of aquatic species. The department will implement this policy as required, which is consistent with the department's *Statewide policy no. 5 – Environmental water provisions policy for Western Australia* on providing water for environmental flows and passage of aquatic life.
		12.1.3	The department is unlikely to approve new applications to take surface water (including direct pumping) from a watercourse during periods of low flow (generally in summer), due to the ecological needs of the system during that time.
		12.1.4	Water levels in some areas of the Collie River may be influenced by dewatering activities in the catchment, from pool supplementation and changes to the baseflow (groundwater fed) component of the system. Anyone making a new application to extract water via a pump on-stream or construction of an off-stream dam should be aware that these activities may influence the flow rates, water levels and quality. The department will advise any new applicants of these risks, including the associated monitoring and management required to minimise these impacts.

12.2	Dam construction	12.2.1	The department may require new dam construction applications to include surveyed characteristics (level, area, volume), so that we can determine the capacity of the dam storage.
		12.2.2	If a dam has the potential to pond water over an adjoining property, the department will require the applicant to seek legal access to the affected property. Where dams exist over multiple property boundaries and the properties are subsequently sold or subdivided, the vendor and purchasers should formalise how the dam will be managed.
		12.2.3	Interference (including the construction of dams and weirs) with the bed and banks of a proclaimed watercourse on private property or a watercourse on Crown land will require a permit as per Sections 11, 17 and 21 of the *Rights in Water and Irrigation Act 1914*. These permits will be subject to certain terms, conditions and restrictions. The department is not responsible for he safety of the design, the method of construction, operation of the works, or action, that would be authorised by a permit to interfere with bed and banks (Rights in Water and Irrigation Act Regulations 2000).
		12.2.4	The department may require applicants for larger dams (> 50 000 kL in capacity) with the potential to have an impact on ecosystems and downstream users, to submit information to support the determination of environmental water requirements (such as channel hydraulics) from a hydrologist or qualified scientific professional (see policy 5.1).
		12.2.5	The department will address the diversion or take of water to fill dams through licence conditions. The department will allocate water up to the allocation limit for the subarea.
13	Trading and transferring licence requirements		
13.1	Transfer and trading	13.1.1	The ability to transfer or trade a water entitlement is provided for by Schedule 1, Division 7 of the *Rights in Water and Irrigation Act 1914* and the in *Statewide policy no. 6 – Transferable (tradeable) water entitlements for Western Australia*
13.2	Assessment process	13.2.1	The department may require additional information from the applicant to assess potential impacts of the trade, at the applicant's expense. All applicants required to provide the department with additional information on their trade must comply with *Statewide policy no. 17 – Timely submission of required further information*.
		13.2.2	Applicants must apply for trades on the prescribed forms available from the department and must pay the prescribed fee.

13.3	General	13.3.1	Water entitlements can only be traded between like-for-like water sources (for example, surface water to surface water and aquifer to aquifer)
		13.3.2	Where licences are required for non-intensive stock, domestic or garden purposes they may not be traded. These licences will be transferred upon change of ownership of the land.
		13.3.3	The unused component of a licensed entitlement is not tradeable, subject to *Statewide policy no. 11 – Management of unused licensed water entitlements*, but the licensee may enter into third party agreements to use this unused component.
		13.3.4	Trades are limited to the consumptive (used) part of the water entitlement. Accurate measurement of use of the water entitlement is a prerequisite for trading and must be proven to the department before the entitlement can be traded. The used component of the licensed entitlement is the amount of water actually abstracted for use.
		13.3.5	Dewatering entitlements are not tradeable or transferable.
		13.3.6	Water efficiency gains can be traded and will not be recouped by the department. Water efficiency gains are the effect of implementing more efficient distribution systems for using a licensed entitlement. As a result this component can be traded.
13.4	Approval to trade	13.4.1	Licensed entitlements cannot be traded if the department considers the use does not comply with the original licence.
		13.4.2	The department may refuse a trade in order to prevent non-efficient uses and monopolies in water, protect other users and the environment from unacceptable impacts, ensure that the outcomes are beneficial to the state, and meet policy and planning objectives. Upon refusal, the applicant may appeal against the department's decision at the State Administrative Tribunal.
13.5	Reliability of supply	Licensees contemplating entering the trading market for an additional or new entitlement for groundwater should ensure that the entitlement can be pumped sustainably before they enter into the trade and that the application complies with the provisions of this plan. This may require submission of an application to carry out exploratory works or pump testing (see *Statewide policy no. 19 – Hydrogeological reporting associated with a groundwater well licence*).	
13.6	Environmental trades	An existing licensed entitlement for water can be purchased without demonstrating use if the entitlement is purchased for protection of a critical environmental asset (including ecological and/or social protection). Water traded for this purpose is effectively traded for non-consumptive use to the identified critical environmental asset. This water then becomes the property of the asset and can not be reallocated.	
13.7	Market facilitation	The department will not be involved in setting the market price for trading of water entitlements. However, the prices paid for trades will be publicly available from the department.	

13.8 New entitlements	13.8.1	It is the responsibility of both the vendor and the purchaser to provide requested information to the department, including proof of use (measured through metering) as part of the assessment of the trade.
	13.8.2	Trading of water entitlements involves a licence holder (vendor) trading all or part (transfer) of their licensed entitlement to another water user (purchaser). A trade of a licensed entitlement can occur only with the approval of the department. Trading policies and restrictions may apply.
13.9 Leasing	Leasing of licensed entitlements can only be accepted for a period less than the vendor's licence entitlement tenure, and only where impacts from the purchaser's bore location are acceptable (assessed as per new licence application) for the duration of the lease agreement.	
13.10 Change in ownership	13.10.1	When selling a property the owner (vendor) can apply to either transfer the licence to the new owner, trade the licence to a person(s) other than the new owner (purchaser), keep the licence and use it on another property or surrender the licence. Each change in ownership requires a new licence application.
	13.10.2	The volume of the traded entitlement will be added to the purchaser's existing licence or a new entitlement granted. Licence conditions will be added to both the existing and transferred licence to minimise or monitor any potential local impacts of the additional volume.
	13.10.3	Water licences are transferable upon sale of the land on which the bore, soak, pump or dam is situated. The department will not alter water entitlements as long as water continues to be used in the same manner. However the department may apply more stringent conditions.
	13.10.4	If a vendor's entitlement is traded permanently (full or part entitlement) the vendor's licence will be amended (partial trade) or cancelled (full trade).

2.6 Monitoring program

The department has designed a regional monitoring program to:

- assess the response of each resource to abstraction
- allow for the evaluation of the performance of the plan.

The monitoring program will be implemented by the department and the main water users. The program consists of four sub-programs. These are:

- groundwater levels and quality
- ground and surface water interaction
- surface water quality
- surface water flow.

A summary of each of the monitoring sub-programs is provided in Appendix J.

The department has an extensive regional groundwater monitoring bore network (80 bores). This network consists of the Collie Basin Shallow (CBS) and the Collie Regional Monitoring (CRM) series. The large groundwater users – Griffin Coal, Premier Coal and Verve Energy will share responsibility for monitoring the network. The department has determined the required zones of monitoring responsibility based on the proportion of groundwater abstracted and area of potential impact of each of the large water users. These zones are presented in Appendix J.

Note: This monitoring program only relates to the department's regional monitoring network and does not include the monitoring of additional licensee monitoring bores.

2.7 Implementing the plan

Part of ensuring that this plan is successful in managing the Upper Collie water resources is setting out detail of how it will be implemented, evaluated and reviewed.

Actions required to implement this plan are summarised in Table 10.

Table 10
Actions for implementing the plan

No	Action	Responsibility	Timeline
1	**Monitoring program:** Implement the monitoring program defined in this plan	South West Region	Ongoing
2	**Monitoring data management:** Enter and store data into the WIN database	Measurement and water information	Ongoing
3	**Resource assessment:** Complete an annual resource assessment report which summarises resource trends	Water Resource Assessment	Annually
4	**Evaluation statement**: Produce and release the public evaluation statement	South West Region	Annually
5	**Environmental management:** Formalise the environmental releases required from the Harris and Wellington reservoirs	Allocation planning	Fourth quarter 2009
6	**Licensing:** Review licences in the Cardiff subarea and amend in line with the recovery objective over two stages Review large groundwater licences (> 500 000 kL/yr) to ensure a consistent approach to monitoring, as per this plan. Conduct on-site surveys of large groundwater licences (> 500 000 kL/yr) to ensure that water use and management is in accordance with licence conditions.	South West Region South West Region South West Region	Stage 1: Fourth quarter 2009 Stage 2: Fourth quarter 2010 Fourth quarter 2009 Annually

2.8 Evaluating the plan

To identify whether the management strategies identified in the plan are working to achieve the objectives of the plan, the department will release an evaluation statement each year. The statement will identify:

- the status of water use
- the status of all actions required by the plan
- performance against the plan objectives
- any amendments to the plan.

The performance indicators by which the department will evaluate the plan's objectives are summarised in Table 11. Resource performance indicators, for groundwater levels and surface water flows, directly relate to the monitoring program outlined in Appendix J.

Table 11
Performance indicators for each allocation objective

Objective	Performance indicator
To increase accountability for water use and its associated impacts.	The total volume of water actually abstracted for the year is less than or equal to the total entitlements for each resource. All large water users (>500,000 kL/yr) are 100% compliant with licence conditions.
To abstract water resources up to or equal to the allocation limit (other than mine dewatering that has approval under a state agreement).	The volume of water allocated is within the allocation limit for each resource for the year. The abstraction of mine dewater does not exceed the level required for safe mining at each of the mine sites.
To recover over allocated water resources.	The volume of water recouped by the department from each over-allocated resource since the release of this plan. The number of over-allocated resources in the plan area decreases. Groundwater level change (m) from 2009, (or pre-recorded or baseline levels) in and adjacent to: • abandoned underground mines • river pools of the Collie River South Branch • adjacent to recovering open-cut voids.

Table 11
Performance indicators for each allocation objective

Objective	Performance indicator
To protect existing ecological, social and cultural values	The number of validated reports of abstraction or release affecting Aboriginal cultural values or any other environmental and social values decreases each year following the release of the plan. The volume of water released from the Wellington and Harris reservoirs for the environment over the year. This includes scouring of the Wellington Reservoir. Groundwater level change (m) and quality change (salinity, pH and heavy metals) from 2009 (or pre-recorded or baseline) levels in: • state forest where no abstraction occurs • at each mine site and across the area of potential impact. Number and type of avoidance/remediation or mitigation measures taken by large water users to manage the impact of water use on the environment. River pool water levels are maintained by supplementation to an acceptable level: • Cardiff Pool on the Collie River South Branch • Duderling and Buckingham pools on the Collie River East Branch.
To protect the security of supply for existing water users.	The number of validated reports from water users of declines in groundwater levels or streamflow decreases each year following the release of the plan. The department does not have to issue directions to licensees to stop or reduce the take of water. Groundwater level change and quality (salinity and pH) change from 2009 (or pre-record or baseline) levels in the: • local vicinities of Collie, Allanson, Cardiff, Collieburn settlements. • at each major bore field and across the area of potential impact. Inflows into the Harris Reservoir are maintained in accordance with those calculated by the department using mean annual flow data from the 1975–2003 period. Inflows into the Wellington Reservoir are maintained in accordance with those calculated by the department using mean annual flow data from the 1975–1999 period.
To ensure that water is used in the most efficient way.	The volume of efficiency gains reported by licensees increases.
To achieve the highest value use of water resources.	The percentage of mine dewater from each mine site used by: • mining companies for on site use • mining companies for environmental needs • third parties • released to the environment
To minimise water quality impacts of abstraction and use and where possible increase the quality of the water resources.	Water quality change (ph, salinity and heavy metals) from 2009 (and/or pre recorded levels) at: • groundwater fed river pools of the Collie River south and east branches • abandoned underground mines • adjacent to recovering open-cut voids • the department's existing key baseline monitoring sites.

2.9 Reviewing the plan

The department will evaluate this plan each year through the annual evaluation statement. The evaluation statement will identify if a formal review of the plan is required. This may be the case if the plan is not meeting its objectives or if new issues emerge that are not covered by the strategies of this plan.

Western Australia is currently updating and reviewing its legislation for the state's water resources. Any significant changes in legislation that may affect this plan will also trigger a review of the plan, including replacing the plan with a new statutory water allocation plan.

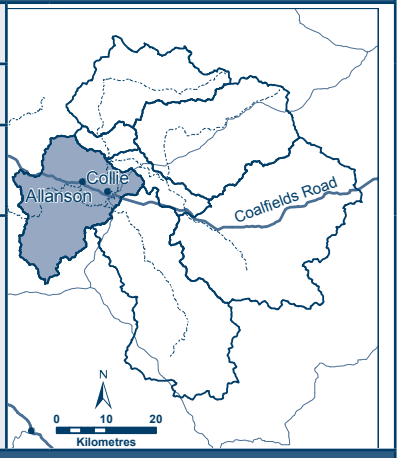
Appendices

Upper Collie water allocation plan

August 2009

Subarea description

Area	398 km^2
Proclamation	Collie River Irrigation District 25 September 1931
Shires	Shires of Collie, Dardanup and Donnybrook–Balingup
Land and water use	• freehold, state forest 4, 15, 25 and 26, Crown reserves and small portions of unallocated Crown land. • stock and domestic use • commercial water use includes non-intensive agriculture, small amount of horticulture, viticulture and aquaculture



Major issues

High salt level of the Collie River and the Wellington Reservoir, managing private self-supply abstraction in addition to abstraction from the reservoirs, potential unlicensed commercial use, water source protection.

Allocation and water availability

Resources	Allocation limit GL/yr	Available water[1]
Wellington Reservoir	85.1	Yes
Mungalup Reservoir	0.5	No
Collie River main stream	1.0	Yes

Hydrology and flow characteristics (1975–2003)

Clearing	32%	
Resources	Collie River (and smaller branches Hamilton River and Yabberup and Bussell brooks) and Wellington and Mungalup reservoirs	
	Non-cumulative (subarea contribution only)	Cumulative total (total, includes flow from upstream)
Mean annual flow	50.7 GL/yr	148.3 GL/yr
Flow range	17.4–132.3 GL/yr	35.3–443.0 GL/yr
Mean annual salinity	772 mg/L TDS (marginal)	820 mg/L TDS (marginal)
Annual salinity range	221–2646 mg/L TDS (fresh–moderately saline)	444–2116 mg/L TDS (fresh–moderately saline)

A Appendix
Collie River Central subarea reference sheet

August 2009

Surface water monitoring		
Resources	Stream gauging station	Period of record
Collie River	Mungalup Tower 612002	1969–present (operating)
Collie River	Central Collie gauging station 612035	1953–present (operating)
Hamilton River	Hamilton River gauging station 612004	1972–present (operating)

Alterations to flow	
Major structures	Wellington and Mungalup reservoirs
Releases and alterations	Releases from the upstream Harris Reservoir influence flow through parts of the subarea.
Major abstractions	From the Wellington Reservoir for irrigation
Private farm dams (so far identified)	27 on-stream storages with an estimated capacity of 0.4 GL. Seven off-stream storages with an estimated capacity of 0.008 GL.
Plantations	A number of plantations are present.

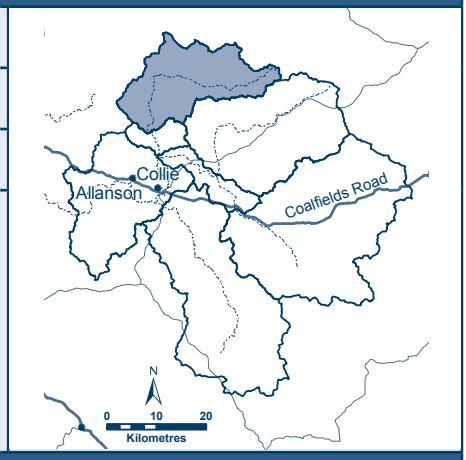
Considerations for water management include, but are not limited to:	
Ecological	No significant ecological sites identified.
Cultural	Collie River itself and numerous sites along the river such as the Minninup pools, Boronia and Snake Gully.
Social	*Towns and localities:* Town site of Collie and the communities of Allanson and Mungalup. *Recreational sites:* Collie River, Minninup pools and Wellington Reservoir.

1 Available water (AW) is the allocation limit (AL) minus estimated current use. Yes if AW is ≤70% AL, Limited if AW is between 70 and 100% AL, and No is if AW is 100% AL.

August 2009

Subarea description

Area	328 km²
Proclamation	Collie River Irrigation District 25 September 1931
Shires	Shires of Collie and Harvey
Land and water use	• predominantly state forest and conservation reserve • no commercial water use identified within the subarea besides take from the Harris Reservoir



Major issues

Optimising use of the high quality water from the reservoir, managing and regulating reservoir releases.

Allocation and water availability

Resources	Allocation limit GL/yr	Available water[1]
Harris Reservoir	15.0	No
Harris River main stream	0	N/A

Hydrology and flow characteristics (1974–2003)

Clearing	2%
Resources	Harris Reservoir
Mean annual flow	20.0 GL/yr
Flow range	1.4–67.3 GL/yr
Mean annual salinity	203 mg/L TDS (fresh)
Annual salinity range	110–763 mg/L TDS (fresh–marginal)

B

Appendix
Harris subarea reference sheet

August 2009

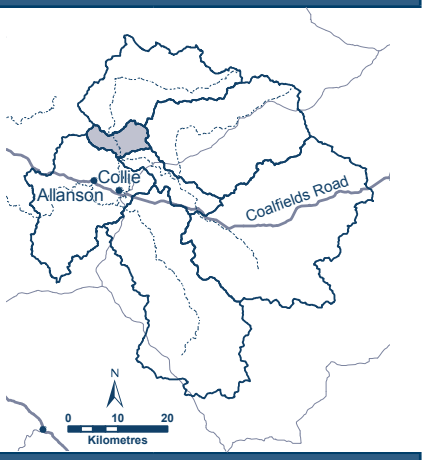
Surface water monitoring	
Resources	Stream gauging station
Harris River	Tallanalla gauging station (operated by the Water Corporation) is located below the reservoir (within the Lower Harris subarea) as a compliance point for environmental water provision releases made from the reservoir.
Alterations to flow	
Major structures	Harris Dam
Releases and alterations	Ecological water requirement releases throughout the year conducted as part of the current operation strategy (requires review). Social salinity mitigation releases over drier months.
Major abstractions	From the Harris Reservoir for public water
Private farm dams (so far identified)	None identified
Plantations	None identified
Considerations for water management include, but are not limited to:	
Ecological	No significant ecological sites identified. **Note:** Healthy ecological condition.
Cultural	Harris River itself and numerous sites along the river.
Social	No significant social sites identified. *Public water supply:* The Water Corporation take water from the Harris Reservoir for public water supply for the great southern regional towns scheme supply

1 Available water (AW) is the allocation limit (AL) minus estimated current use. Yes if AW is ≤70% AL, Limited if AW is between 70 and 100% AL, and No is if AW is 100% AL.

August 2009

Subarea description

Area	54 km²
Proclamation	Collie River Irrigation District 25 September 1931
Shire	Shire of Collie
Land and water use	• predominantly state forest 15 and a few freehold properties • stock and domestic use • commercial use includes viticulture and aquaculture



Major issues

Supply for stock and domestic use, maintaining freshwater flow contributions to downstream catchment, minimising regulation of local tributaries (Norm, Scar and Hanson brooks).

Allocation and water availability

Resources	Allocation limit GL/yr	Available water1
Harris River	1.2	Yes

Hydrology and flow characteristics (1975–2003)

Clearing	9%
Resources	Harris River, Norm, Scar and Hanson brooks
Mean annual flow	7.5 GL/yr (not including contributions from spills or releases from the Harris Reservoir)
Flow range	3.2–18.4 GL/yr
Mean annual salinity	759 mg/L TDS (marginal)
Annual salinity range	371–1584 mg/L TDS (fresh–brackish)

C

Appendix
Lower Harris subarea reference sheet

August 2009

Surface water monitoring		
Resources	Stream gauging station	Period of record
Harris River	Tallanalla S612017	N/A
Harris River	Stubbs Farm S612036	1952–1977 (not operating)
Norms Brook	Norms Road Tributary S612029	1983–1987 (not operating)
Scar Brook	Scar Road Creek S612028	1983–1987 (not operating)
Hanson Brook	Hanson Brook S612027	1983–1987 (not operating)

Alterations to flow	
Major structures	Harris Dam regulates downstream flows
Releases and alterations	Releases throughout the year from the Harris Reservoir
Major abstractions	None
Private farm dams (so far identified)	38 off-stream storages with an estimated combined capacity of ~0.05 GL. Three on-stream storages with an estimated combined capacity of 0.02GL.
Plantations	None identified

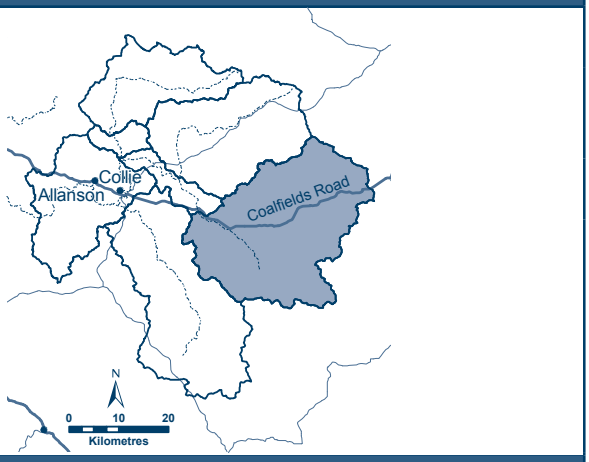
Considerations for water management include, but are not limited to:	
Ecological	No significant ecological sites identified.
Cultural	Harris River itself and numerous sites along the river.
Social	Recreational sites: Site directly below the Harris Dam.

1 Available water (AW) is the allocation limit (AL) minus estimated current use. Yes if AW is ≤70% AL, Limited if AW is between 70 and 100% AL, and No is if AW is 100% AL.

August 2009

Subarea description

Area	792 km²
Proclamation	Collie River Irrigation District 25 September 1931
Shire	Shire of Collie
Land and water use	• freehold and state forest. • stock and domestic use – non-intensive agriculture • no commercial water use.



Major issues

Poor water quality, salinity recovery through diversion, surface water and groundwater interaction, impacts on surface water baseflow from groundwater abstraction, reduced baseflow and induced recharge to groundwater, management of dewater discharge to the river.

Allocation and water availability

Resources	Allocation limit GL/yr	Available water[1]
Collie River East Branch	14.0	Yes

Hydrology and flow characteristics (1975–2003)

Clearing	32%
Resources	Collie River East Branch
Mean annual flow	29.1 GL/yr
Flow range	5.1–90.9 GL/yr
Mean annual salinity	2379 mg/L TDS (moderately saline)
Annual salinity range	783–9244 mg/L TDS (fresh–saline)

D Appendix
Collie River East Branch subarea reference sheet

August 2009

Surface water monitoring		
Resources	Stream gauging station	Period of record
Collie River East Branch	Buckingham Mill gauging station 612038	1999–present (operating)
	Collie River East Diversion monitoring station 612050	2005–present (operating)

Alterations to flow	
Major structures	Unregulated
Releases and alterations	Large volumes of mine dewater were discharged to the Collie River East Branch from the Chicken Creek Coal mine site until the mid 1990s. Large volumes of mine dewater are expected to be discharged in the future from the Premier mine.
Major abstractions	Collie River East Branch at Buckingham for salinity recovery.
Private farm dams (so far identified)	48 off-stream storages with an estimated combined capacity of 0.01 GL. Four on-stream storages with an estimated combined capacity of 0.07 GL.
Plantations	Are present
Drainage	Unidentified

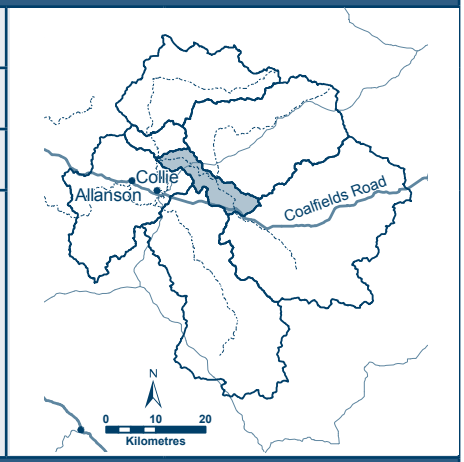
Considerations for water management include, but are not limited to:	
Ecological	No significant ecological sites identified. **Note:** poor ecological condition due to salinity.
Cultural	Collie River itself and numerous sites along the river such as the Waugul pool.
Social	*Recreation sites*: Duderling Pool, the Cabbage Trees.

1 Available water (AW) is the allocation limit (AL) minus estimated current use. Yes if AW is ≤70% AL, Limited if AW is between 70 and 100% AL, and No is if AW is 100% AL.

August 2009

Subarea description

Area	91 km²
Proclamation	Collie River Irrigation District 25 September 1931
Shires	Shires of Collie and West Arthur
Land and water use	• state forest, freehold, reserves and small portions of unallocated Crown land • stock and domestic use – non-intensive agriculture • no commercial water use • includes the sites of the Collie power stations, Bluewaters 1 and 2 power stations, and areas of active coal mining (Ewington Mine)



Major issues

Poor water quality, salinity recovery through diversion, surface water and groundwater interaction, impacts on surface water from groundwater abstraction, reduced baseflow and induced recharge to groundwater, supplementation of affected river pools, management of potential mine dewater releases into the river.

Allocation and water availability

Resources	Allocation limit GL/yr	Available water[1]
Lower Collie River East Branch	1.0	Yes

Hydrology and flow characteristics (1975–2003)

Clearing	42%	
Resources	Lower Collie River East Branch	
	Non-cumulative (subarea contribution only)	Cumulative (total, includes flow from upstream)
Mean annual flow	9.4 GL/yr	42.2 GL/yr
Flow range	3.8–22.2 GL/yr	6.6–135.8 GL/yr
Mean annual salinity	1218 mg/L TDS (brackish)	1782 mg/L TDS (brackish)
Annual salinity range	558–2093 mg/L TDS (marginal–moderately saline)	676–7576 mg/L TDS (marginal–saline)

E

Appendix
Lower Collie River East subarea reference sheet

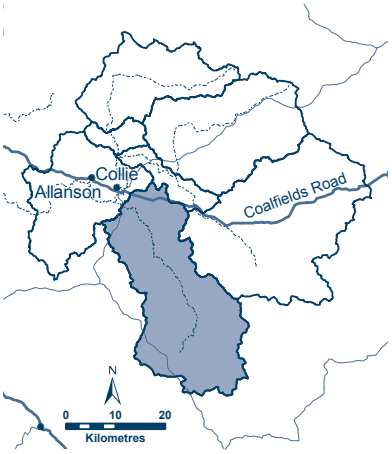
August 2009		
Surface water monitoring		
Resources	Stream gauging station	Period of record
Lower Collie River East Branch	Coolangatta 612001	1968–present (operating)
Alterations to flow		
Major structures	Unregulated	
Releases and alterations	Large amounts of mine dewater were discharged to the Collie River East Branch from the Chicken Creek Coal mine site until the mid-1990s. River pools are supplemented with groundwater over the drier months. Large volumes of dewater discharge expected in the future from the Premier mine.	
Major abstractions	none	
Private farm dams (so far identified)	Two off-stream storages with an estimated combined capacity of 0.001 GL. Six on-stream storages with an estimated combined capacity of 0.03 GL.	
Plantations	None identified	
Drainage	None identified	
Considerations for water management include, but are not limited to:		
Ecological	No significant ecological sites identified. **Note:** poor ecological condition due to salinity.	
Cultural	Collie River itself and numerous sites along the river.	
Social	*Towns and localities:* Includes the small community of Buckingham. *Recreational sites:* Buckingham Town and Buckingham Bridge pools.	

1 Available water (AW) is the allocation limit (AL) minus estimated current use. Yes if AW is ≤70% AL, Limited if AW is between 70 and 100% AL, and No is if AW is 100% AL.

August 2009

Subarea description

Area	661 km^2
Proclamation	Collie River Irrigation District 25 September 1931
Shires	Shires of Collie, Boyup Brook and West Arthur
Land and water use	• state forest 4, 24, 26 and 29, Crown leases and reserves and freehold • includes the Muja power station site • Northern half has been extensively mined for coal and now contains abandoned underground and open-cut mine voids including Lake Stockton and Lake Kepwari Coal mining ceased in the mid-1990s. • stock and domestic use – non-intensive agriculture • commercial water use is for mine void rehabilitation.



Major issues

Groundwater recovery and interaction with surface water, acidification, pool supplementation and mine void rehabilitation (Lake Kepwari), commercial unlicensed use. Mine water discharge.

Allocation and water availability

Resources	Allocation limit GL/yr	Available water[1]
Collie River South Branch	5.0	Yes

Hydrology and flow characteristics (1975–2003)

Clearing	22%
Resources	Collie River South Branch
Mean annual flow	24.2 GL/yr
Flow range	4.1–77.6 GL/yr
Mean annual salinity	772 mg/L TDS (marginal)
Annual salinity range	221–2640 mg/L TDS (fresh–moderately saline)

F

Appendix
Collie River South Branch subarea reference sheet

August 2009

Surface water monitoring		
Resources	Stream gauging station	Period of record
Collie River South Branch	South Branch 612034	1952–present (operating)

Alterations to flow	
Major structures	Unregulated
Releases and alterations	Historically, large amounts of mine dewater were diverted to the Collie River South Branch. This ceased in the 1990s. Some mine dewater continues to run-off (through Stockton mine void and across private property) into the Collie River South Branch at Chinaman's pool, from Griffin Coal's Ewington mine. River pools are supplemented with groundwater over the drier months. The South Branch has been modified to flow around the rehabilitating Lake Kepwari (Western 5B) coal mine void.
Major abstractions	Filling and rehabilitation of Western 5B – Lake Kepwari.
Private farm dams (so far identified)	48 off-stream storages with an estimated combined capacity of 0.01 GL. Four on-stream storages with an estimated combined capacity of 0.07 GL.
Plantations	None identified
Drainage	None identified

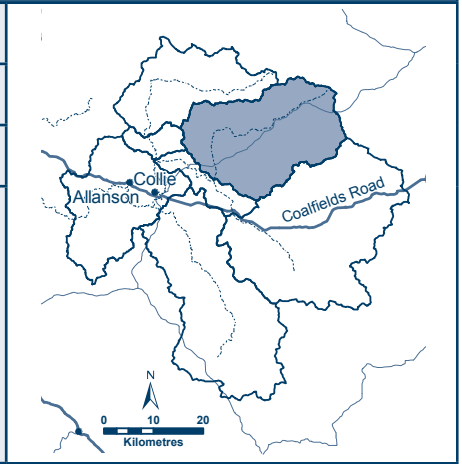
Considerations for water management include, but are not limited to:	
Ecological	No significant ecological sites identified.
Cultural	Collie River itself and numerous sites along the river.
Social	*Towns and localities:* Includes the communities of Cardiff and Collieburn. *Recreational sites:* Cardiff Town Pool, Chinamans Pool.

1 Available water (AW) is the allocation limit (AL) minus estimated current use. Yes if AW is ≤70% AL, Limited if AW is between 70 and 100% AL, and No is if AW is 100% AL.

August 2009

Subarea description

Area	515 km²
Proclamation	Collie River Irrigation District 25 September 1931
Shire	Shire of Collie
Land and water use	• state forest 15 and 24, small number of freehold properties • stock and domestic use – non-intensive agriculture • no commercial water use • silviculture • three salinity recovery catchment sites (Dons, Ernies and Lemons)



Major issues

Preserving fresh quality water for the environment.

Allocation and water availability

Resources	Allocation limit GL/yr	Available water[1]
Bingham River	0	No

Hydrology and flow characteristics (1975–2003)

Clearing	14%
Resources	Bingham River
Mean annual flow	11.7 GL/yr
Flow range	1.0–40.3 GL/yr
Mean annual salinity	318 mg/L TDS (fresh)
Annual salinity range	132–1495 mg/L TDS (fresh–brackish)

G

Appendix
Bingham subarea reference sheet

August 2009

Surface water monitoring		
Resources	Stream gauging station	Period of record
Bingham River	Palmer 612014	1975–present (operating)

Alterations to flow	
Major structures	Unregulated
Releases and alterations	None
Major abstractions	None
Private farm dams (so far identified)	10 off-stream storages with an estimated combined capacity of 0.01 GL. 11 on-stream storages with an estimated combined capacity of 0.02 GL.
Plantations	A number of plantations are present
Drainage	None identified

Considerations for water management include, but are not limited to:	
Ecological	No significant ecological sites identified. **Note:** Good ecological condition.
Cultural	The river itself and numerous sites along it.
Social	None identified.

1 Available water (AW) is the allocation limit (AL) minus estimated current use. Yes if AW is ≤70% AL, Limited if AW is between 70 and 100% AL, and No is if AW is 100% AL.

August 2009

Subarea description

Area	153 km^2
Proclamation	Collie groundwater area 17 June 1977
Shire	Shire of Collie
Land and water use	• state forest, Crown reserve, freehold and small portions of unallocated Crown land • stock and domestic users • commercial uses include power station water supply and irrigation

Major issues

Highly disturbed system, groundwater over-abstraction, groundwater recovery, groundwater acidification, surface and groundwater interaction, supplementation of groundwater-fed river pools over the drier months, rehabilitation of open-cut mine voids, recovery of underground mine voids, increased leakage between aquifers, aquaculture use of mine voids (Western 5H), use of mine voids (Western 5H) as an emergency water source for power generation.

Allocation and water availability

Resource	Allocation limit GL/yr	Available water[1]
Nakina	0	No
Muja	1.79	Over-allocated
Lower Collie Group	2.51	Over-allocated
Stockton	0	No

H Appendix
Cardiff subarea reference sheet

August 2009

Hydrogeology	
Aquifer	Description
Nakina	The Nakina aquifer is unconfined. Other aquifers subcrop beneath the Nakina at certain points. Net recharge of the Nakina is 0 GL/yr.
Muja	The Muja aquifer is confined and has a net recharge of 5.2 GL/yr in the Cardiff subarea. Induced leakage occurs between Muja and other confined aquifers.
Lower Collie Group	The Lower Collie Group contains the Premier, Allanson, Ewington and Westralia confined aquifers. Net recharge of this group of aquifers in the Cardiff subarea is 6.6 GL/yr. Induced leakage occurs between these and other confined aquifers.
Stockton	The Stockton aquifer is confined and has a net recharge of 0.6 GL/yr in the Cardiff subarea. Induced leakage occurs between Stockton and other confined aquifers.
Groundwater monitoring	
Aquifer	Monitoring bore
Nakina	CRM 05, 40, 50, 51, 53, 75, 79, 80, 86
Muja	CBS 25A, 25B, 30 CRM 43, 47, 52, 54, 55, 60, 61, 63, 71, 72, 73, 82, 83
Lower Collie	CBS 01, 02A, 02B, 05A, 06, 08, 09A, 13,18, 20, 26 CRM 01, 17, 18, 19, 20, 21, 23, 24, 33, 34, 42,44,48,56,62,69, 76, 78, 81, 84, 87
Stockton	CBS 10, 23 CRM 12
Considerations for water management include, but are not limited to:	
Ecological	No significant ecological sites identified.
Cultural	Many cultural sites of significance throughout the subarea.
Social	*Towns and localities:* Includes Collie town site and the communities of Cardiff and Collieburn.

1 Available water (AW) is the allocation limit (AL) minus estimated current use. Yes if AW is ≤70% AL, Limited if AW is between 70 and 100% AL, and No is if AW is 100% AL.

August 2009

Subarea description

Area	77 km^2
Proclamation	Collie groundwater area 17 June 1977
Shire	Shire of Collie
Land and water use	• state forest, freehold and small portions of unallocated Crown land • stock and domestic users • commercial uses include power station water supply • mine dewatering – Muja, Premier and Ewington mine sites

Major issues

Highly disturbed system, groundwater over-abstraction, groundwater acidification, supplementation of groundwater-fed river pools over the drier months, rehabilitation of mine voids, surface and groundwater interaction, increased leakage between aquifers, mine dewater management, storage and disposal of diverted East Branch water, managing and accounting for the cumulative impacts of abstractions and mine dewatering.

Allocation and water availability

Resource	Allocation limit GL/yr	Available water[1]
Nakina	0	No
Muja	0	No
Lower Collie Group	2.2	Over-allocated
Stockton	0	No

Hydrogeology

Resource	Description
Nakina	The Nakina aquifer is unconfined. Other aquifers subcrop beneath the Nakina at certain points. Net recharge of the Nakina is 0 GL/yr.
Muja	The Muja aquifer is confined and has a net recharge of 0.2 GL/yr in the Premier subarea. Induced leakage occurs between Muja and other confined aquifers.
Lower Collie Group	The Lower Collie Group contains the Premier, Allanson, Ewington and Westralia confined aquifers. Net recharge of this group of aquifers in the Premier subarea is 4.5 GL/yr. Induced leakage occurs between these and other confined aquifers.
Stockton	The Stockton aquifer is confined and has a net recharge of 0.1 GL/yr in the Premier subarea. Induced leakage occurs between Stockton and other confined aquifers.

Appendix
Premier subarea reference sheet

August 2009	
Groundwater monitoring	
Aquifer	Monitoring bore
Nakina	CRM 40, 45, 86
Muja	CBS 28
Lower Collie Group	CBS 05A, 08, 09A, 14C, 11, 20, 21D, 32,34 CRM 04, 09, 10, 15, 18, 19, 25, 29, 30, 31,33, 34, 35, 42, 43, 46, 58, 70, 77, 87
Stockton	CRM 03, 10
Considerations for water management include, but are not limited to:	
Ecological	No significant ecological sites identified.
Cultural	Many cultural sites of significance throughout the subarea.
Social	Groundwater-fed river pools along the East Branch. *Towns and localities:* Includes the community of Buckingham.

1 Available water (AW) is the allocation limit (AL) minus estimated current use. Yes if AW is ≤70% AL, Limited if AW is between 70 and 100% AL, and No is if AW is 100% AL.

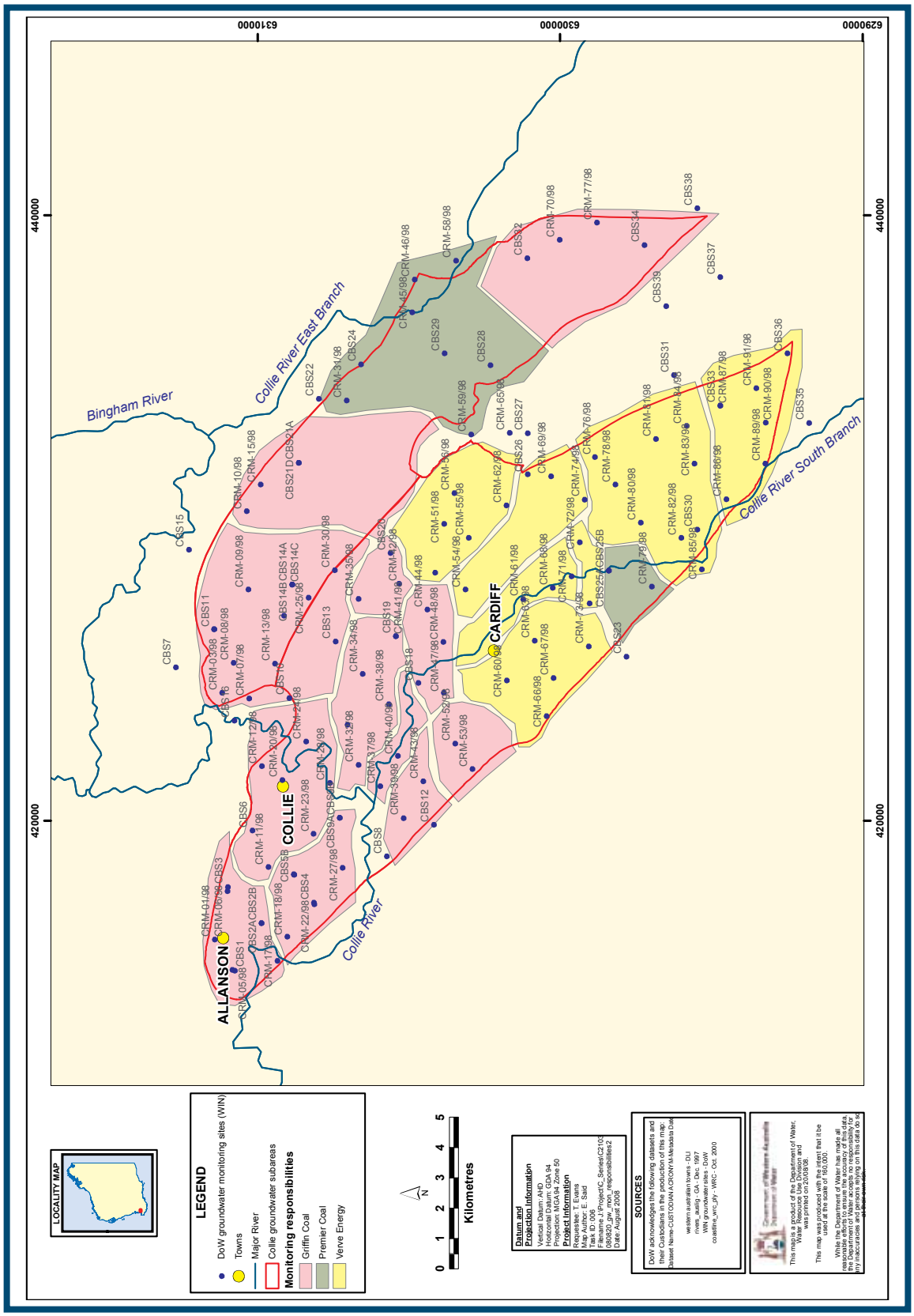


Figure 9
Licensee groundwater monitoring responsibility zones

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Appendix
Upper Collie groundwater and surface water monitoring program

Table 12
Groundwater levels and water quality monitoring program summary

Plan objective	Performance indicator	Parameter and schedule	Site	Responsibility	Resource monitored	Bore
To recover over allocated resources. **To minimise water quality impacts of abstraction and use and where possible increase the quality of the water resources.**	Degree of groundwater level change (m) and quality change (pH , salinity and heavy metals) from 2009, (and/or pre-recorded or baseline levels) in and adjacent to: • abandoned underground mines • river pools of the Collie River South Branch.	Static groundwater levels (m AHD) monthly Temp (°C), pH and EC in March, June, September and December TDS (mg/L), aluminium (Al), copper (Cu), iron (Fe), manganese (Mn), zinc (Zn) in March and September	Western 2 Colliery (W2 borefield)	Verve Energy	Nakina	CRM 75
					Muja	CRM 72
					Lower Collie	
					Stockton	
			Western 6 Colliery (WD6 borefield)	Verve Energy	Nakina	
					Muja	CBS 25A , 25B
					Lower Collie	
					Stockton	
			Western 7 Colliery	Verve Energy	Nakina	
					Muja	CRM 60
					Lower Collie	
					Stockton	
			Long, Walkers, Cox and Cardiff pools	Verve Energy	Nakina	
					Muja	CRM 61, CRM 68, CRM 71
					Lower Collie	
					Stockton	
To protect the security of supply for existing water users (exempt and licensed).	Degree of groundwater level (m) and quality (pH & salinity) change from 2009 (and/or pre-recorded levels at) each major borefield and across the area of potential impact. • local vicinity of Cardiff and Collieburn settlements.	Static groundwater levels (m AHD) monthly Temp (°C), pH and EC September in March, June, September and December	Cardiff borefield	Verve Energy	Nakina	CRM 80
					Muja	CRM 82, CRM 83, CBS 30
					Lower Collie	CRM 76, CRM 78, CRM 81, CRM 84
					Stockton	
			Stockton North Borefield	Verve Energy	Nakina	CRM 51, CRM 50
					Muja	CRM 54, CRM 55
					Lower Collie	CRM 56, CRM 62, CRM 69
					Stockton	
			Stockton South borefield	Verve Energy	Nakina	
					Muja	
					Lower Collie	CBS 26
					Stockton	
			Cardiff	Verve Energy	Nakina	
					Muja	CRM 63, CRM 73 (and refer to CRM 60)
					Lower Collie	
					Stockton	

Table 12
Groundwater levels and water quality monitoring program summary

Plan objective	Performance indicator	Parameter and schedule	Site	Responsibility	Resource monitored	Bore
To protect existing ecological, social and cultural values **To minimise water quality impacts of abstraction and use and where possible increase the quality of the water resources**	Degree of groundwater level (m) and quality change (salinity, pH & heavy metals) from 2009 (and/or pre-recorded) levels at : • state forest where no abstraction occurs • at each mine site and across the area of potential impact • adjacent to recovering open cut mine voids • river pools of the Collie River East Branch.	Static groundwater levels (m AHD) monthly Temp (°C), pH and EC in March, June, September and December TDS (mg/L), aluminium (Al), copper (Cu), iron (Fe), manganese (Mn), zinc (Zn) in March and September	Kepwari	Premier Coal	Nakina	CRM 79
					Muja	
					Lower Collie	
					Stockton	CBS 23
			Duderling and Buckingham pools	Premier Coal	Nakina	CRM 45
					Muja	
					Lower Collie	
					Stockton	
			Premier mine Pit 1/3 & 4	Premier Coal	Nakina	
					Muja	CBS 28
					Lower Collie	CRM 58, CRM 46, CRM 31, CBS 29
					Stockton	
			Ewington 1 mine	Griffin Coal	Nakina	
					Muja	
					Lower Collie	CRM 03, CRM 04, CRM 09, CRM 21, CRM 25, CRM 30, CBS 13, CBS 14C, CBS 11
					Stockton	CRM 03, CBS 10
			Ewington II mine	Griffin Coal	Nakina	
					Muja	
					Lower Collie	CRM 15, CRM 10, CBS 21D
					Stockton	
			Lake Stockton	Griffin Coal	Nakina	
					Muja	
					Lower Collie	CRM 35, CRM 42, CBS 20
					Stockton	
			Muja mine	Griffin Coal	Nakina	
					Muja	
					Lower Collie	CRM 70, CRM 77, CBS 32, CBS 34
					Stockton	
			State forest	Griffin Coal	Nakina	CRM 40, CRM 86
					Muja	CRM 43
					Lower Collie	CRM 18, CRM 19, CRM 33, CRM 34, CRM 87, CBS 05A, CBS 08, CBS 09A
					Stockton	

Table 12
Groundwater levels and water quality monitoring program summary

Plan objective	Performance indicator	Parameter and schedule	Site	Responsibility	Resource monitored	Bore
To protect the security of supply for existing water users (exempt and licensed)	Degree of groundwater level change (m) and quality (salinity and pH) change from 2009 (and/or pre-recorded levels) in the: • local vicinities of Collie, Allanson, Cardiff, Collieburn settlements.	Static groundwater levels (m AHD) monthly Temp (°C), pH and EC in March, June, Sept and December	Collie town site	Griffin Coal	Nakina	
					Muja	
					Lower Collie	CRM 20, CRM 23, CRM 24,CBS 06
					Stockton	CRM 12
			Allanson	Griffin Coal	Nakina	CRM 05
					Muja	
					Lower Collie	CRM 01, CRM 17, CBS 01, CBS 02A, CBS 02B
					Stockton	
			Collieburn	Griffin Coal	Nakina	
					Muja	CRM 47
					Lower Collie	CRM 44, CRM 48, CBS 18
					Stockton	
			Preston Settlement	Griffin Coal	Nakina	CRM 53
					Muja	CRM 52
					Lower Collie	
					Stockton	

Table 13
Groundwater and surface water interaction monitoring

Plan objective	Performance indicator	Site	Responsibility	Parameter (minimum)	Schedule (subject to licence conditions)
To minimise water quality impacts of abstraction and use and where possible increase the quality of the water resources	The degree of water quality change (pH, salinity and metals) from 2009, (and/or pre-recorded) levels in: • groundwater fed river pools of the Collie River south and east branches.	Long, Walkers, Cox and Cardiff pools – Collie River South Branch	Verve Energy	Temp (°C), pH, EC @ 25°C, TDS (mg/L) Aluminium (Al), copper (Cu), iron (Fe), manganese (Mn), zinc (Zn)	Fortnightly
		Duderling and Buckingham pools – Collie River East Branch	Premier Coal	Temp (°C), pH, EC @ 25°C, TDS (mg/L) Aluminium (Al), copper (Cu), iron (Fe), manganese (Mn), Zinc (Zn)	Fortnightly
	The degree of water quality change (pH, salinity and heavy metals) from 2009 (and/or pre recorded) levels at: • dewater discharge sites.	All dewater discharge sites	Griffin Coal and Premier Coal	Temp (°C), pH, EC @ 25°C, TDS (mg/L)	Weekly
				Aluminium (Al), copper (Cu), iron (Fe), manganese (Mn), Zinc (Zn)	Monthly

Table 14
Surface water quality monitoring

Plan objective	Performance indicator	Responsibility	Site	Parameter measured	Schedule
To minimise water quality impacts of abstraction and use and where possible increase the quality of the water resources	The degree of water quality change (physical, chemical and biological) from 2009 (and/or pre-recorded levels) at key sites.	Department of Water	Mungalup (S 612002)	TN, TP, pH, uncompensated conductivity, temperature, dissolved oxygen, salinity, turbidity, colour (Hazen)	Monthly
			Collie South (S 612034)		
			Buckingham (S 612038)		

Table 15
Surface water flow monitoring through the department's stream gauging network

Plan objective	Performance indicator	Site	Subarea
To protect existing ecological, social and cultural values at a low level of risk from abstraction, by ensuring water users identify possible impacts of their water use at an early stage	Mean annual flows to be above or meet the specified mean annul ecological water requirement at the end of each self-supply subarea, at the relevant gauging station.	Buckingham Mill (612038)	Collie River East Branch
		Coolangatta Farm (612001)	Lower Collie River East
		Collie River South Branch (612034)	Collie River South Branch
To protect the security of supply for existing water users (exempt and licensed)	Degree of change in mean annual flow characteristics at the end of each surface water subarea from the 1975 – 2003 periods.	Buckingham Mill (612038)	Collie River East Branch
		Coolangatta Farm (612001)	Lower Collie River East
		Collie River South Branch (612034)	Collie River South Branch
		Palmer (612014)	Bingham River
	Degree of change in the mean annual flow from the 1975 – 2003 period into the Harris Reservoir.	Harris Reservoir	Harris River
	Degree of change in the mean annual flow from the 1975 – 1999 period into the Wellington Reservoir.	Wellington Reservoir	Collie River Central

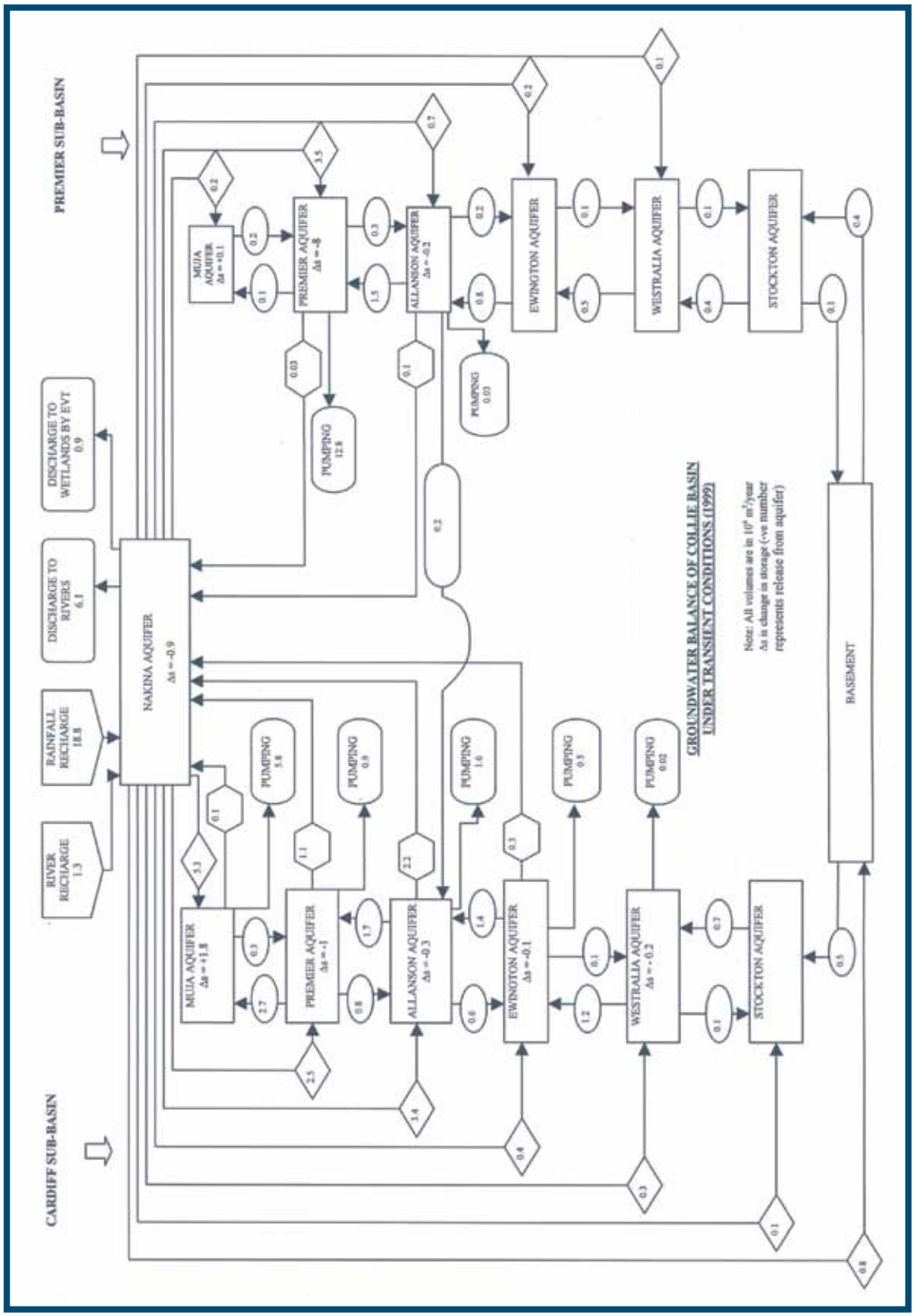
Table 16
General groundwater monitoring requirements for production and dewatering and monitoring bores

Type	Parameter	Schedule for production and dewatering bores*	Schedule for monitoring bores*
Abstraction		Monthly	Not applicable
Water levels (m)		Monthly	Quarterly (March, June, September and December)
Basic groundwater quality	Temp (°C), pH, EC @ 25°C, TDS (mg/L)	Monthly	Quarterly (March, June, September and December)
Metals	Aluminium (Al), copper (cu), iron (Fe), manganese (Mn), zinc (Zn)	Quarterly (March, June, September and December)	If applicable – biannually (March and September)
Major components analysis	Total hardness/alkalinity ($CaCO_3$), calcium (ca), magnesium (Mg) , sodium (Na), potassium (K), carbonate (CO_3) bicarbonate (HCO_3), chloride (Cl), sulfate (SO_4), nitrate (NO_3), silica (SiO_2), aluminium (Al), iron (Fe), manganese (Mn)	Biannually (March and September)	If applicable – biannually (March and September)
Other compounds	Oil and grease, arsenic (As) TSS, cadmium (Cd), nickel (Ni), molybdenum (Mo), Hydroxide (HO), Total kjeldahl nitrogen (TKN), total phosphorus (TP), ammonia (NH_3), nitrate (NO_3), nitrite (NO_2), filterable reactive phosphorus (FRP)	If applicable – biannually (March and September)	If applicable – biannually (March and September)

* Note: These requirements are general only and may change depending on the baseline water quality and risk of change.

Appendix K

Groundwater balance of the Collie Coal Basin
as assessed in 1999 (derived from the groundwater model)



Appendix
Classification of salinity

From stream salinity status and trends in south-west Western Australia.

Salinity type	Range mg/L TDS
Fresh	< 500
Marginal	501–1000
Brackish	1001–2000
Moderately saline	2001–5000
Saline	5001–10 000
Highly saline	10 001–35 000
Brine	> 35 000

When measuring volumes of water, the units change according to how much water we are talking about. For instance:

- a large cool drink bottle would be measured in litres
- a year's water supply for a household in kilolitres
- a weekly town water supply in megalitres
- a large dam in gigalitres.

This is how it works:

Litre (L)	**one litre**	**1**
Kilolitre (kL)	**one thousand litres**	**1000**
	one cubic metre (m^3)	
Megalitre (ML)	**one million litres**	**1 000 000**
	one thousand kilolitres	
	one thousand cubic metres	
Gigalitre (GL)	**one billion litres**	**1 000 000 000**
	one million kilolitres	
	one million cubic metres	
	one thousand megalitres	

Shortened forms	
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
EPA	Environmental Protection Authority
TDS	Total dissolved solids
RiWi Act	Rights in Water and Irrigation Act 1914

Glossary

Abstraction	The permanent or temporary withdrawal of water from any source of supply, so that it is no longer part of the resources of the locality.
Allocation limit	Annual volume of water set aside for use from a water resource.
Aquifer	A geological formation or group of formations capable of receiving, storing and transmitting significant quantities of water. Usually described by whether they consist of sedimentary deposits (sand and gravel) or fractured rock. Aquifer types include unconfined, confined and artesian.
Baseflow	The component of streamflow supplied by groundwater discharge.
Bore	An opening in the ground, normally vertical hole drilled in soil or rock, made or used to obtain access to underground water. This is equivalent to the description of a 'well' in *the Rights In Water and Irrigation Act 1914.*
Catchment	Area of land from which rainfall run-off contributes to a single watercourse, wetland or aquifer.
Climate change	A change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.
Commercial use	Water taken from a resource that is directly or indirectly used for commercial purposes. This includes water taken for public and private purposes and water stored in a dam.
Confined aquifer	An aquifer lying between confining layers of low permeability strata (such as clay, coal or rock) so that the water in the aquifer cannot easily flow vertically.
Consumptive use	The use of water for private benefit consumptive purposes including irrigation, industry, urban and stock and domestic use.
Dam	An embankment constructed to store or regulate surface water flow. A dam can be constructed in or outside a watercourse.
Dewatering	Removing underground water to facilitate construction or other activity. It is often used as a safety measure in mining below the watertable or as a preliminary step to development in an area.
Discharge	The water that moves from the groundwater to the ground surface or above, such as a spring or the ocean. This includes water that seeps onto the ground surface, evaporation from unsaturated soil, and water extracted from groundwater by plants (evapotranspiration) or engineering works (groundwater pumping).

Domestic bore	A bore used for providing the in-house and household garden watering requirements.
Drawdown	The lowering of a watertable resulting from the removal of water from an aquifer or reduction in hydraulic pressure.
Ecologically sustainable yield	The amount of water that can be abstracted over time from a water resource while maintaining the ecological values (including assets, functions and processes).
Ecological values	The natural ecological processes occurring within water-dependent ecosystems and the biodiversity of these systems.
Ecological water requirement	The water regime needed to maintain the ecological values (including assets, functions and processes) of water-dependent ecosystems at a low level of risk.
Environment	Living things, their physical, biological and social surroundings, and interactions between all of these.
First-in first-served	A process by which groundwater entitlements are allocated in the order in which licence applications are received by the Department of Water.
Fit-for-purpose	Water use is matched to an appropriate quality.
Flow	Streamflow in terms of m^3/yr, m^3/d, or ML/yr or GL/yr. May also be referred to as discharge.
Gigalitre (GL)	(GL). A volumetric measure equal to one million kilolitres or one billion litres.
Groundwater	Water which occupies the pores and crevices of rock or soil beneath the land surface.
Groundwater area	The boundaries that are proclaimed under the *Rights in Water and Irrigation Act 1914* (WA) and used for water allocation planning and management.
Groundwater recharge	The rate at which infiltration water reaches the watertable.
Groundwater subarea	Areas defined by the Department of Water within a groundwater area, used for water allocation planning and management.
Groundwater-dependent ecosystem	An ecosystem that is dependent on groundwater for its existence and health.
Kilolitre (kL)	A unit of volume in the metric system, equal to 1000 litres. Weighs approximately one tonne.
Licence	A quantity of water specified on a formal permit which entitles the licence holder to 'take' water from a watercourse, wetland or underground source, in accordance with the *Rights in Water and Irrigation Act 1914*.
Non-artesian well	A well, including all associated works, from which water does not flow, or has not flowed, naturally to the surface but has to be raised, or has been raised, by pumping or other artificial means.
Off-stream Storage	Storages (such as farm dams, turkey's nest dams) that are not on defined waterways or watercourses and primarily store water either extracted from rivers or aquifers, or from flood water emanating from rivers or from local catchment runoff.

On-stream storage	Storages (such as farm dams) that are built on or within a defined waterway or watercourse.
Over-allocated	Total water use is greater than the allocation limit for a designated management area.
Plantation	A non-irrigated crop of trees grown or maintained so that the wood, bark, leaves and/or essential oils can be harvested or used for commercial purposes (including through the commercial exploitation of the carbon absorption capacity of the forest vegetation).
Precautionary principle	Taking a cautious approach to development and environmental management decisions when information is uncertain, unreliable or inadequate.
Purchaser	A person receiving a trade. Any person permitted by the *Rights in Water and Irrigation Act 1914* to hold a water licence is potentially able to purchase a licensed entitlement.
Proclaimed resource	An area proclaimed under the *Rights in Water and Irrigation Act 1914* to enable water licensing, that is used for water allocation planning and management. Surface water is proclaimed as a surface water area, irrigation district or proclaimed river under Part III Division 1B s.6 of the RiWI Act.
Recharge	Water that infiltrates into the soil to replenish a groundwater aquifer.
Riparian right	Right of a riparian landowner to take water from a watercourse, that flows through their property, unlicensed and free of charge for the purpose of stock and domestic use, without sensibly diminishing the flow of water downstream.
Salinity	The measure of total soluble salt or mineral constituents in water. Water resources are classified based on salinity in terms of total dissolved solids (TDS) or total soluble salts (TSS). Measurements are usually in milligrams per litre (mg/L) or parts per thousand (ppt).
Self-supply	Water diverted from a source by a private individual, company or public body for their own individual requirements.
Social value	A particular in situ quality, attribute or use that is important for public benefit, welfare, state or health (physical and spiritual).
Social water requirement	Elements of the water regime that are needed to maintain social and cultural values.
Subarea	A subdivision within a surface or groundwater area, defined for the purpose of managing the allocation of groundwater resources. Subareas are not proclaimed and can therefore be changed internally without being gazetted.
Surface water	Water flowing over or held in streams, rivers and wetlands on the surface of the land.
Surface water management area	Areas defined by the Department of Water, used for water allocation planning and management, which are generally hydrologic basins or parts of basins.
Sustainability	Meeting the needs of current and future generations through integration of environmental protection, social advancement and economic prosperity.
Sustainable groundwater yield	The amount of water that can be abstracted over time from a water resource while maintaining the ecological values (including assets, functions and processes).
Throughflow	The flow of water within, and between, aquifers.

Trade	Sale of part or all of a licensed entitlement, by a licensee (vendor) to a second party (purchaser). This involves moving the point of abstraction from one property to another.
Transfer	A transfer is a change in ownership of the water licence associated with the sale of the property to which the licence applies. There is no change in the location of the abstraction. Licences can be transferred without recompense.
Transferable (tradeable) water entitlement	The ability to transfer or trade a water entitlement, or a part thereof, to another person within a common water resource.
Twin-track approach	Meeting demand through equal consideration of new water resource developments and water efficiency measures.
Unconfined aquifer	The aquifer nearest the surface, having no overlying confining layer. The upper surface of the groundwater within the aquifer is called the watertable. An aquifer containing water with no upper non-porous material to limit its volume or to exert pressure. See Aquifer.
Vendor	A licence holder wishing to trade a water entitlement is referred to as the vendor. Any person permitted by the *Rights in Water and Irrigation Act 1914* to hold a water licence is potentially able to sell a licensed entitlement.
Water-dependent ecosystems	Those parts of the environment, the species composition and natural ecological processes of which are determined by the permanent or temporary presence of water resources, including flowing or standing water and water within groundwater aquifers.
Water efficiency	The minimisation of water use through adoption of best management practices.
Water entitlement	The quantity of water that a person is entitled to take on an annual basis in accordance with the *Rights in Water and Irrigation Act 1914* through a licence.
Watertable	The saturated water level of the unconfined aquifer. Wetlands in low-lying areas are often seasonal or permanent surface expressions of the watertable.
Well	An opening in the ground made or used to obtain access to underground water. This includes soaks, wells, bores and excavations.

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Notes

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