



Government of Western Australia
Department of Water

Busselton–Capel groundwater area

subarea reference sheets

Plan companion for the South West
groundwater areas allocation plan



Busselton-Capel groundwater area subarea reference sheets

Plan companion for the South West groundwater
areas allocation plan

Department of Water

May 2009

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Cover photograph

Vasse-Wonnerup Ramsar wetland

Wayne Davies

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1 Introduction

1.1 Purpose of the plan

The *South West groundwater areas allocation plan* provides the department's direction on the taking and use of groundwater resources in the plan area (Figure 1). The planning process considered the ecological, social and economic values of the water resources, with the community's input from a range of consultation processes over several years. It aims to achieve a balance between current and future users, and the protection of the water-dependent environment.

The plan provides a clear and consistent direction to current and future water users in areas that are under pressure from increasing abstraction and climate change.

1.2 Purpose of the subarea reference sheets

The subarea reference sheets are designed to assist with licensing of groundwater in the plan area by providing local subarea-based information and guidance on the licensing process. The reference sheets will help to inform prospective licence applicants of their local area requirements for water use in a specific subarea and provide general information to assist in the application process.


1.3 Licensing information and the plan


The *South West groundwater areas allocation plan* contains the specific licensing policies and rules that apply to all subareas and must be used in conjunction with this document in any licence assessment process or new application.


The licensing information detailed in this document follows standard statewide protocols and processes used across all plans. For further information please visit the department's website.

Applicants should be aware of the licensing policies and local area rules that may apply to them before submitting their groundwater licence application to the department.

Licensing forms for licence applications can be found on the Department of Water's website: <www.water.wa.gov.au> Doing business with us > Water licensing > Licensing publications and forms > or by contacting one of the South West regional offices.

 Bunbury (08) 9726 4111

 Busselton (08) 9781 0100

 Manjimup (08) 9771 1878

1.4 How to use the subarea reference sheets

The reference sheets provide background information on a particular groundwater subarea. Each subarea has different issues associated with licensing and water management. The reference sheets provide summarised information on the subarea including:

- proclamation, water use and water management issues (Figure 2 and Figures 4–11)
- allocation limits and water availability
- hydrogeology
- ecological, social, cultural and recreational sites of significance that were considered in the assessment process for groundwater licensing
- management zone rules (see Section 5.2 of the *South West groundwater areas allocation plan* for more detail) (Figure 3).

For the full technical detail please see the bibliography of the *South West groundwater areas allocation plan* for a complete reference and recommended reading list.

For a licence application to be assessed it should be consistent with, and meet the requirements of, the *South West groundwater areas allocation plan* and the *Rights in Water and Irrigation Act, 1914*. The reference sheets are not a replacement for a clause 7 (2) licence assessment process under the Act (see Appendix A and Table A1). The information contained in the reference sheets must also be used in conjunction with the following information:

- the principles and objectives for water management described in the *South West groundwater areas allocation plan* (Section 1.2 and Chapter 3 of the plan)
- the policies and rules listed in the *South West groundwater areas allocation plan* (Section 5.1–5.2 of the plan)
- State and Commonwealth legislation relating to water and its use (Appendix B)
- licensing process (Appendix A), unless otherwise stated in the plan
- statewide policies, guidance and allocation notes (Appendix A)
- reviewing the allocation limits for the South West groundwater areas (DoW 2008)
- *South West groundwater areas monitoring program* (DoW 2008)
- *Management triggers and responses for groundwater-dependent ecosystems in the South West groundwater areas* (Del Borrello 2008)
- *Whicher area surface water allocation plan* (DoW 2009).

There are also numerous documents produced by the department and other government agencies that provide information on a range of water management issues that can be used as reference material for licence applications and in the assessment process. The most relevant of these are listed in Appendix B.

Appendix C provides a list of useful departmental websites to access for additional information linked to components of the water management process and used in the licence assessment process. Any licence application should be consistent with other departmental plans and other government agencies plans or strategies where applicable.

Please note that all data presented have specified dates of collection and interpretation. New and updated information should be collected and used where appropriate. All technical and supporting documents are available on the department's website <www.water.wa.gov.au/allocationplanning>.

Prospective licensees and licensing officers need to be aware that within a 2 km buffer along either side of the subarea boundary line the aquifer may or may not be accessible, and that hydrogeological investigations may be needed.

1.5 Water information data requests

The Department of Water monitors water levels and water quality in its monitoring bore network, storing the data on our water information network (WIN). This information is up-to-date and available upon request using the data request form found here:

<www.water.wa.gov.au> Tools >Monitoring and data>

or by contacting one of the department's regional offices in the South West. The form is electronic and can be emailed or posted to us.

For more information on current water level trends please see *Groundwater level trends analysis for the South West groundwater areas* (Golder 2008). Updates of water level monitoring will be available annually in the evaluation statement (See Chapter 6 of the *South West groundwater areas allocation plan*).

Plan companion for the
South West groundwater areas allocation plan

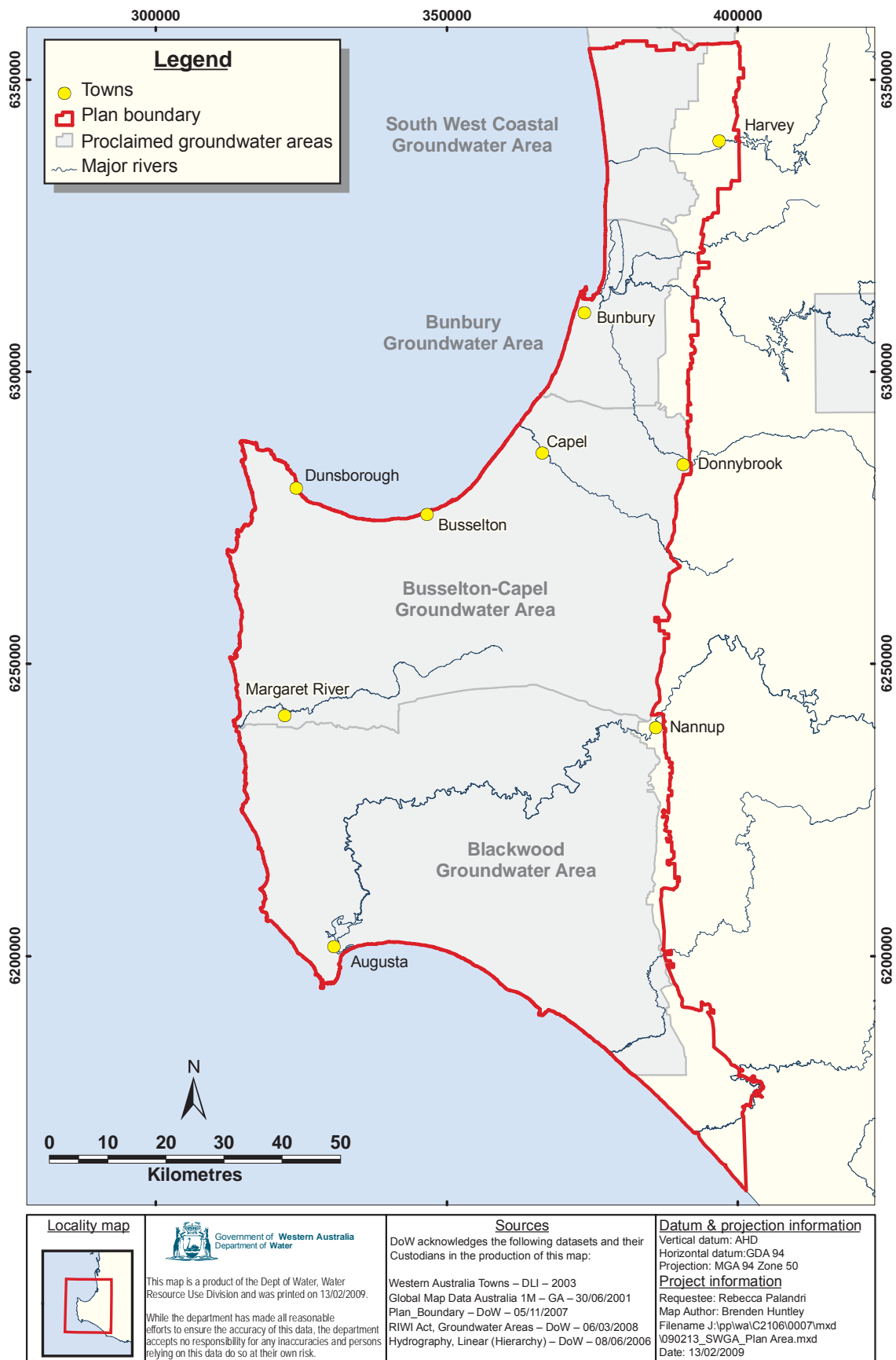


Figure 1 The plan area

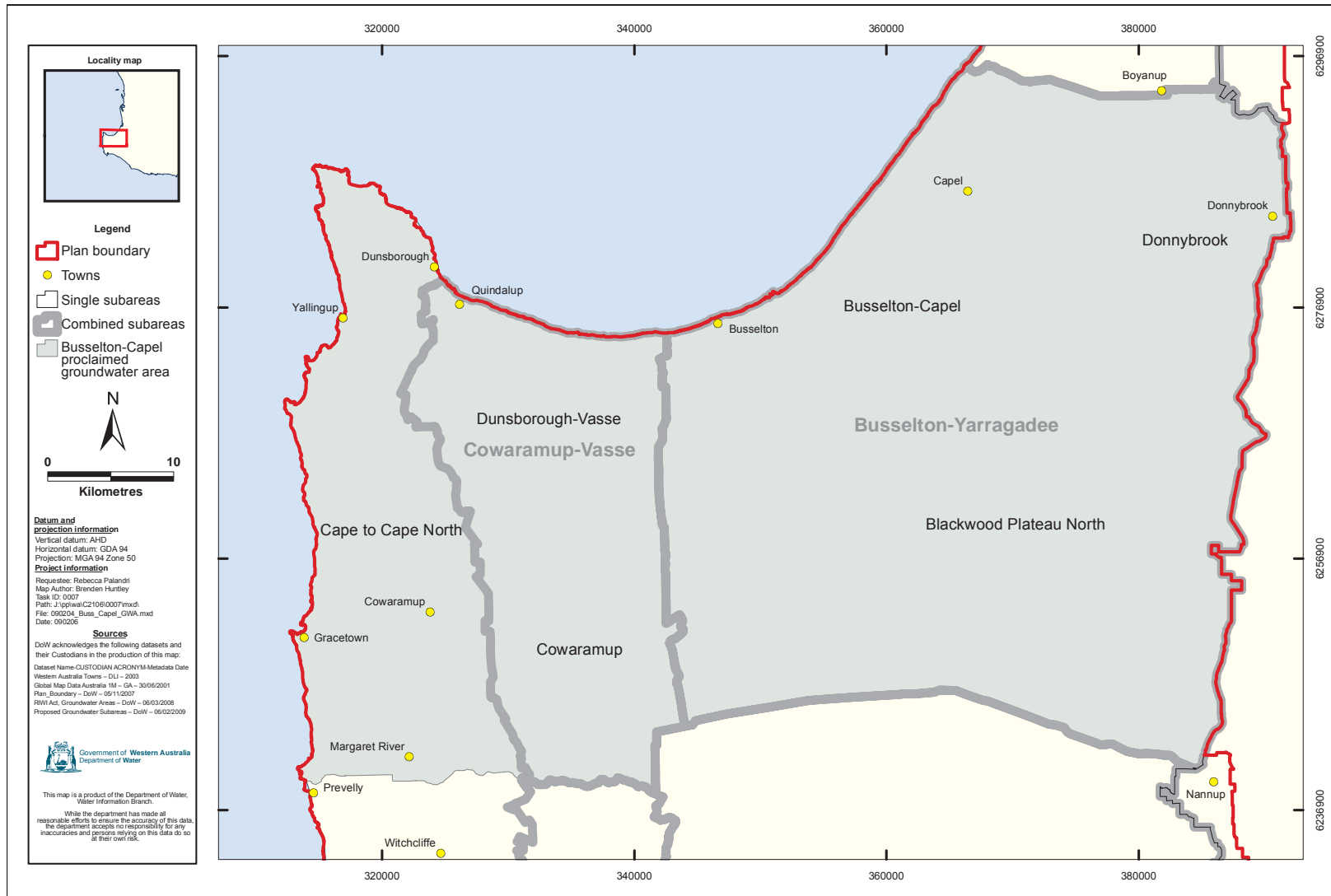


Figure 2 Subarea boundaries in the Busselton–Capel groundwater area

**Plan companion for the
South West groundwater areas allocation plan**

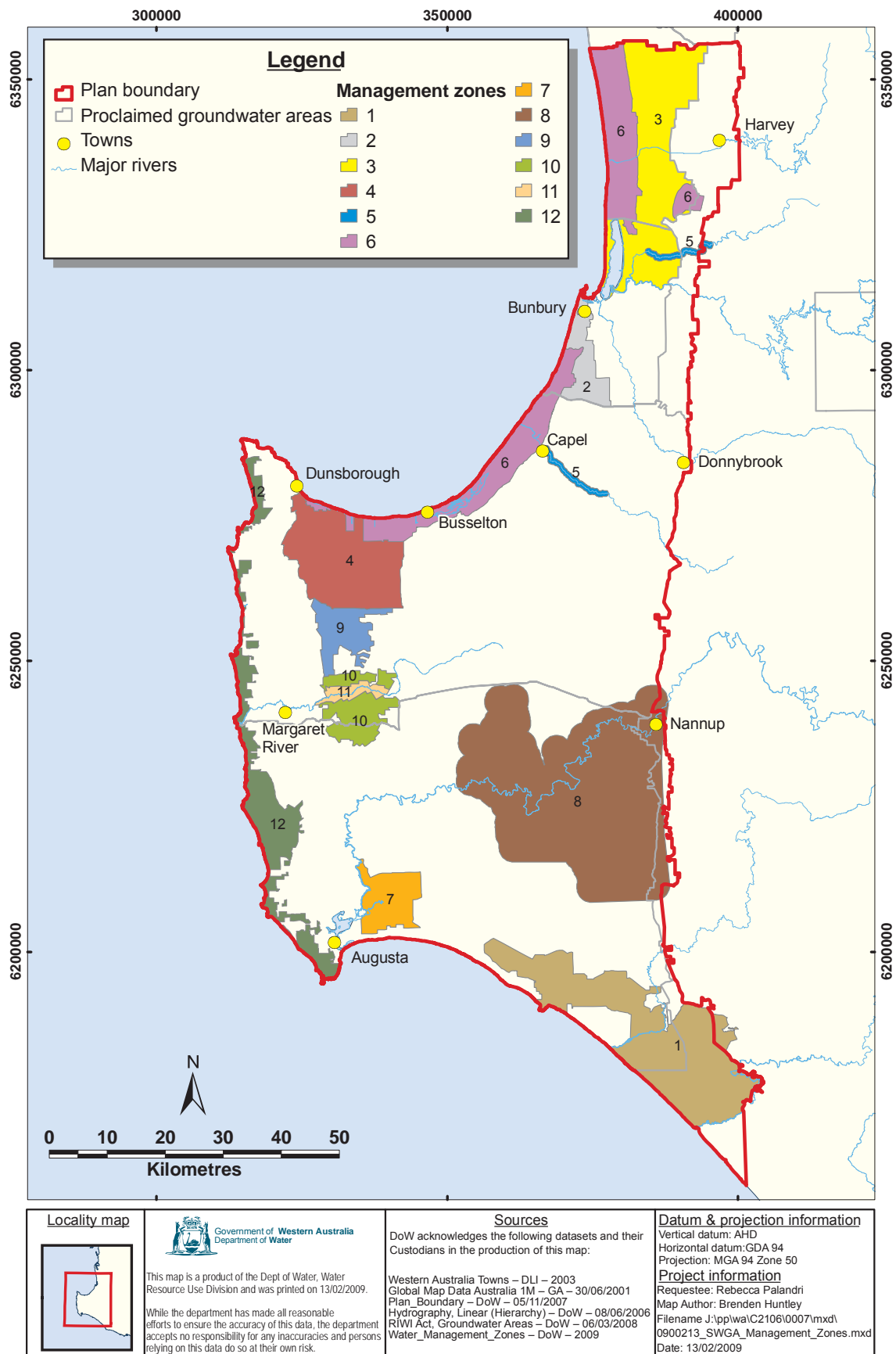


Figure 3 Management zones

2 Subarea reference sheets

In assessing a licence application we undertake a clause 7 (2) assessment under the provisions of the *Rights in Water and Irrigation Act 1914*. In conducting this assessment we consider the impacts from the abstraction of the water and its use on ecological, cultural, social and economic factors.

Important sites and values that we consider have been listed in the subarea reference sheets. These are not the full list of values or sites, but the most relevant to water management for a particular subarea that we consider for all groundwater licence applications. Some of the sections of the subarea reference sheets are discussed below.

Ecological

We currently monitor various groundwater-dependent ecosystem (GDE) sites listed in the subarea reference sheets, including implementing their associated management triggers and responses if the water level criteria are breached (Del Borrello 2008).

There are also ecological water requirement (EWR) sites that have been determined through various investigations and studies across the plan area and are a guide to acceptable water level drawdowns near these sites. These sites are not currently monitored. However they are used in assessing licence applications. The full list of sites is available in Hyde 2006 and Del Borrello 2008.

Many groundwater-dependent ecosystem and ecological water requirement sites contain or are linked to declared rare flora, declared rare fauna, threatened ecological communities, environmental protection policy wetlands, Australian national conservation areas, Ramsar wetlands and numerous water courses and their associated pools, bed and banks.

Where these sites are not covered as groundwater-dependent ecosystem or ecological water requirement sites they are listed in the subarea reference sheets to highlight their presence, as they are considered in managing groundwater abstraction. These sites may or may not be groundwater-dependent and as such, if investigation work has not previously been carried out, licensees may be requested to undertake an investigation in order to prove that the proposed drawdown will not adversely affect these sites.

Cultural

The claimant groups listed and any reference to Aboriginal sites of significance (listed heritage sites) have been extracted from the Department of Indigenous Affairs database. The information only refers to those claims that have been determined and the sites are listed on the permanent register. The listed sites in the subarea reference sheets are directly related to water management and a full search is always undertaken during a licence assessment to ensure that the proposed impacts are acceptable. Applicants may be required to undertake work associated with Aboriginal heritage if a site is likely to be disturbed.

Social

The major social water use values considered are public and private drinking water (including domestic, stock and garden use) and recreational sites. The localities in each subarea are listed to help licensees find out which subarea they are located in. Although there are many different types of recreational sites related to water, only those which are known to be groundwater-dependent are listed.

Economic

The economic aspects of water management are covered by the sections on water use by current licensees, available water and the issues for management. All licence applications are assessed using this information to protect existing uses within the amount of available water and the constraints on accessing the water resource.

2.1 Busselton-Yarragadee

Busselton–Yarragadee																				
Subarea description																				
Area	2021.4 km ²	Licensed water use (November 2008)																		
Proclamation	Busselton–Capel groundwater area 1984, varied in 1989	Yarragadee: 44 759 750 kL/yr <table border="1" style="display: none;"> <caption>Licensed water use (November 2008)</caption> <thead> <tr> <th>Category</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>Dairy purposes</td> <td>0.2%</td> </tr> <tr> <td>General agriculture</td> <td>0.1%</td> </tr> <tr> <td>Irrigated pasture</td> <td>0.5%</td> </tr> <tr> <td>Public water supply</td> <td>38.0%</td> </tr> <tr> <td>Viticulture</td> <td>0.5%</td> </tr> <tr> <td>Domestic, stock and garden</td> <td>19.2%</td> </tr> <tr> <td>Mining and industry</td> <td>22.6%</td> </tr> <tr> <td>Service sector</td> <td>0.7%</td> </tr> </tbody> </table>	Category	Percentage	Dairy purposes	0.2%	General agriculture	0.1%	Irrigated pasture	0.5%	Public water supply	38.0%	Viticulture	0.5%	Domestic, stock and garden	19.2%	Mining and industry	22.6%	Service sector	0.7%
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Domestic, stock and garden	19.2%																			
Mining and industry	22.6%																			
Service sector	0.7%																			
Shire	Shires of Augusta–Margaret River, Nannup, Donnybrook, Capel and Busselton																			
Rainfall	900–1100 mm																			
Allocation and water availability kL/yr																				
Aquifer	Allocation limit	Available water																		
Yarragadee	45 500 000	Fully allocated. Contact the Busselton office for more information.																		
Issues for water management																				
<p>The Yarragadee Aquifer is currently fully allocated. The public water supply reserve is accessible for short term (< 3 yrs) non-renewable purposes subject to the policies in the <i>South West groundwater allocation plan</i>. Bore location and abstraction volume is likely to be restricted close to surface water features.</p> <p>Environmental management triggers and responses also apply. See <i>Management triggers and responses for groundwater-dependent ecosystems in the South West groundwater areas</i>, Del Borrello 2008 for more information.</p>																				
Hydrogeology																				
Aquifer	Description																			
Yarragadee	<p>The Yarragadee Aquifer is present within the Bunbury Trough of the Southern Perth Basin. It consists of four units all of which are present in the subarea. Unit 3 is where the aquifer is predominantly accessed. This section of the aquifer becomes shallower closer to the Busselton fault (200–400 m below ground level) and deepens and thickens towards the Darling fault (600–1000 m below ground level). The formation is predominantly sandstone and siltstone.</p> <p>Aquifer throughflow moves north to discharge off the point near Bunbury and out into Geopraphe Bay. The southern part of the subarea includes some of the recharge and discharge (St John Brook) areas of the Yarragadee Aquifer on the Blackwood Plateau. There is little vertical flow between the Yarragadee and the Leederville aquifers across most of the subarea.</p>																			

Busselton–Yarragadee	
	The aquifer is confined in most areas. Water levels in monitoring bores have been declining up to 2 m over the last 10 years on the coastal plain. Abstraction impacts are evident in local areas. This is the major aquifer for large-scale irrigation projects and public water supply for the subarea. The aquifer currently provides large flow rates for production bores that require allocations > 100 000 kL/yr. Groundwater salinity generally ranges from < 200–400 mg/L.
Considerations for water use include, but are not limited to, the following	
Ecological	
<p><i>Wetlands and waterways:</i> The Capel River and Blackwood tributaries (including St. Johns Brook) receive part of their base flow from the Yarragadee Aquifer. There are no wetlands identified as being dependent on the Yarragadee Aquifer.</p> <p><i>Groundwater-dependent ecosystems and ecological water requirement sites:</i> There is an ecological water requirement site identified 12 km south of Capel town centre with a maximum drawdown criteria 0.25 m below ground level (see Hyde 2006 for more information). It is not currently monitored.</p>	
Cultural	
<p><i>Native Title claimant:</i> South West Boojarah, Harris Family and Gnaala Karla Booja.</p> <p><i>Aboriginal Heritage sites:</i> The Capel River and the Blackwood River Waugal are identified sites of Aboriginal significance. There are several unregistered sites on St John Brook.</p>	
Social	
<p><i>Towns and localities:</i> Towns of Busselton, Capel, Donnybrook.</p> <p><i>Public water supply:</i> The Busselton Water Board supplies drinking water for Busselton and its surrounding suburbs from the Yarragadee aquifer. The Water Corporation supplies Capel and Peppermint Grove from the Yarragadee Aquifer. Water has been reserved in this subarea for public water supply for drinking water purposes (350 000 kL/yr).</p> <p><i>National Parks, reserves and state forest:</i> More than 50% of the subareas are covered by state forest and the Whicher and Tuart Forest National Parks.</p> <p><i>Recreational sites:</i> The Capel and Blackwood rivers and their tributaries, including permanent pools are recreational sites of significance.</p>	
Management zones that apply in this subarea	
5	<p>Known areas of groundwater baseflow from regional aquifers</p> <p>Manage groundwater abstraction to avoid impact on groundwater baseflow in the Capel and Brunswick rivers. Does not cover the Margaret and Blackwood rivers (see management zone 8–11).</p>
8	<p>Discharge and recharge (groundwater) areas of the Blackwood River and Yarragadee outcrop area (recharge zone)</p> <p>Minimise the potential impacts from regional abstraction which may affect water levels in the recharge area and cause changes to the discharge zones on the Blackwood River and tributaries, affecting associated GDE.</p> <p>Minimise the potential impact from local abstraction close to the river (downstream of Darradup). Increase monitoring and minimise impacts on the recharge zone from regional abstraction.</p>
Additional assessment and licensing requirements apply in the areas covered by a management zone. Please refer to Section 5.2 of the <i>South West groundwater areas allocation plan</i> for more detail.	

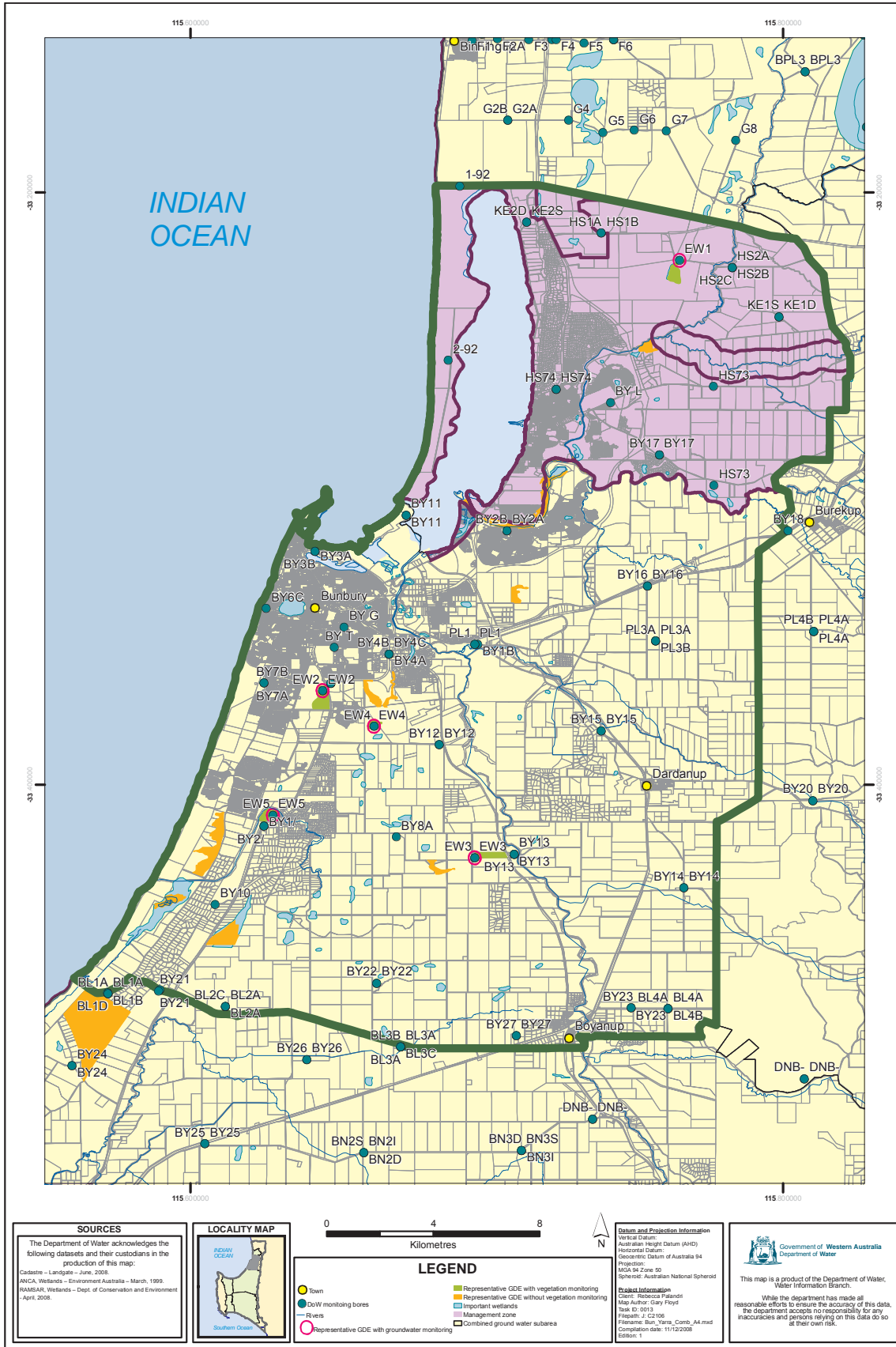
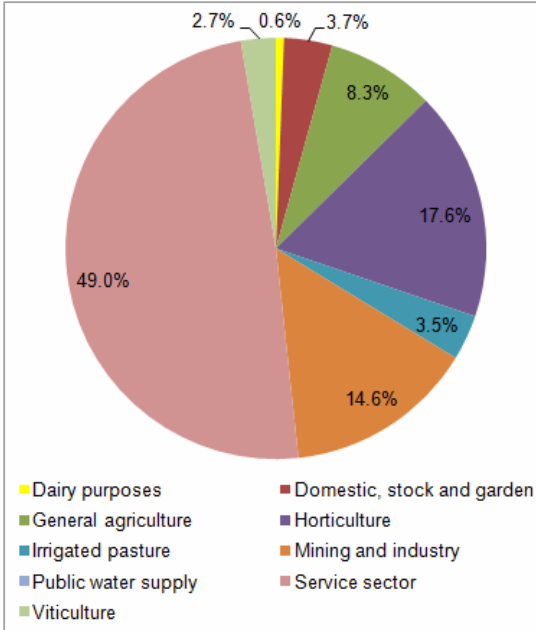
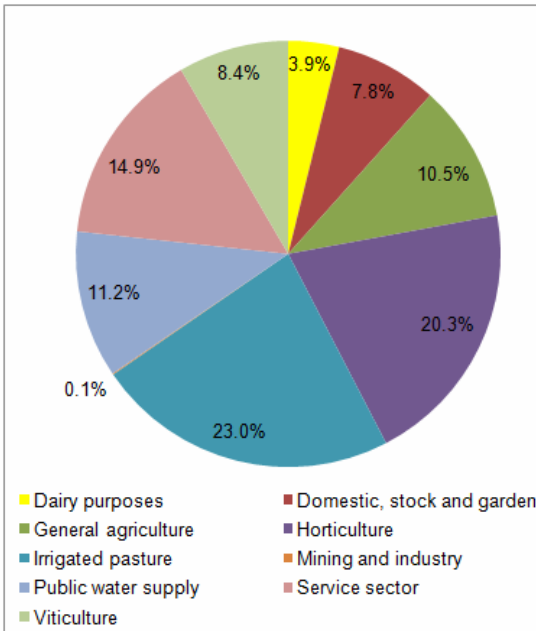


Figure 4 Busselton–Yarragadee subarea

2.2 Busselton-Capel

Busselton–Capel		
Subarea description		
Area	757.3 km ²	Licensed water use (November 2008) <i>Superficial: 4 320 165 kL/yr</i> 
Proclamation	Busselton–Capel groundwater area 1984	
Shire	Shire of Busselton and the Shire of Capel	
Rainfall	800–1100 mm	
Allocation and water availability kL/yr		
Aquifer	Allocation limit	Available water
Superficial	7 200 000	Contact the Busselton office for up-to-date availability.
Surficial (Blackwood)	800 000	
Leederville	10 500 000	
Issues for water management		
<p>There is a high risk of potential acid sulfate soils in both the Superficial and Leederville aquifers. There are numerous threatened ecological communities, declared rare flora or fauna, environmental protection policy wetlands and other wetlands of importance in this subarea which are potentially groundwater-dependent.</p> <p>Environmental management triggers and responses apply. See <i>Management triggers and responses for groundwater-dependent ecosystems in the South West groundwater areas</i>, Del Borrello 2008 for more information.</p> <p>Abstraction on the coast has restrictions (management zone 6) to maintain the seawater interface. As a result the location and depth of draw points is likely to be restricted along the coast. Monitoring of water quality may be included as a licence condition.</p>		
		<i>Leederville: 8 035 800 kL/yr</i> 

Busselton–Capel	
Hydrogeology	
Aquifer	Description
Superficial	<p>The Superficial Aquifer forms an unconfined aquifer beneath the Swan coastal plain, with a thin saturated thickness of < 5 m. The Superficial formation collectively includes the Tamala Limestone, Bassendean Sand, Guildford formation and Yoganup formation.</p> <p>Consequently there is a large variation in permeability, salinity, recharge rates and soil type. There are areas of high potential acid sulfate soil risk throughout the formation.</p> <p>The soil is predominantly clay based, with 40% sand and limestone. The soil increases in clay content closer to the Whicher scarp and the Bunbury Basalt, where the aquifer becomes thin (0–3 m below ground level) and overlies the upper layers of the Leederville.</p> <p>The aquifer is fully recharged and saturated during the winter months resulting in large areas of water logging. However the extensive drainage network captures and diverts most of the excess water. Groundwater salinity increases from < 1000 mg/L towards the southern boundary to around 7000 mg/L towards the coast.</p>
Leederville	<p>The Leederville formation consists predominantly of the Upper and Lower Vasse members overlying the deeper Yarragadee formation. Depth of the aquifer ranges from 15–200 m below ground level (below the Superficial Aquifer) depending on the site location and distance from the coast.</p> <p>The thickness of the aquifer increases significantly to the west, towards the Busselton fault. Water level falls have been recorded near the coast in response to increased pumping. Groundwater salinity ranges across the subarea up to 1500 mg/L in the shallower parts of the aquifer towards the coast. The aquifer has a high iron content.</p>
Considerations for water use include, but are not limited to, the following	
Ecological	
<p><i>Wetlands and waterways:</i> The main watercourses are Capel, Preston, Vasse, Abba, Sabina and Ludlow rivers, Tren Creek, Gynudup and Walsall brooks. These watercourses and the Vasse–Wonnerup estuary and Stirling wetland systems have been modified by drainage on the coastal plain area.</p> <p>There are over 30 registered environmental protection policy wetlands with the majority close to the coast, linked to the Vasse–Wonnerup (Ramsar and Australian national conservation area (ANCA) wetland and water body) and Stirling wetlands. The remaining wetlands are in small groups either side of the Bussell Highway.</p> <p>The wetland systems include the Vasse–Wonnerup system, Stirling wetland system, McCarlay’s swamp (ANCA wetland) and the Broadwater wetlands. All environmental protection policy wetlands linked to this area are important for the migratory bird species.</p> <p><i>Threatened ecological communities and declared rare flora sites:</i> Over 60 registered threatened ecological community sites, with the majority located in small reserves on crown land, with several in Ambergate, Capel, Fish Road and Spanish Settlers reserves, Tutunup road/rail reserve and Ludlow Tuart Forest. There are over 100 different species of declared rare flora across over 200 sites, with the majority associated with the locations of the threatened ecological community in the nature reserves. Those species occurring outside the nature reserves occur in road or rail reserves or on private land.</p>	

Busselton–Capel

Groundwater-dependent ecosystems and ecological water requirement sites: The groundwater-dependent ecosystem sites listed below have ecological monitoring associated with them. For more information see Del Borrello 2008. There are numerous ecological water requirement sites which do not have departmental monitoring associated with them but are important and may require additional work if a licence application is submitted near them (see Hyde 2006 for more information).

<i>GDE sites with management trigger and responses</i>	<i>Location</i>	<i>Maximum drawdown m AHD</i>
Ludlow Rail Reserve	E359579 N6280089	7.50
Ruabon Reserve	E361191 N6276284	17.16
Ambergate Reserve	E344961 N6265814	16.85

Cultural

Native Title claimants: South West Boojarah and the Harris Family.

Aboriginal Heritage sites: Over 70 registered sites including water related sites in and around wetlands and rivers which include camp sites, fish ladders, mythological sites and burial sites.

Social

Towns and localities: Towns of Busselton and Capel. The localities of Peppermint Grove, Busselton, Geographe, Reinscourt, Wonnerup, Forrest Beach, Stirling Estate, Elgin, Capel, Ludlow, Ruabon, Tutunup, Abba River, Stratham, Boyanup, The Plains, Capel River, Hithergreen, Yoongarillup, Sabina River, Acton Park, Chapman Hill, Walsall, Ambergate, Bovell, Vasse, Yalyalup, Busselton West and Gwindinup cover this subarea with water supply for domestic purposes from rainwater tanks and exempt groundwater abstraction.

Public water supply: The Busselton Water Board supplies drinking water for Busselton from the Yarragadee and Leederville aquifers. The Water Corporation supplies Capel and Peppermint Grove hamlet with public water supply from the Yarragadee aquifer.

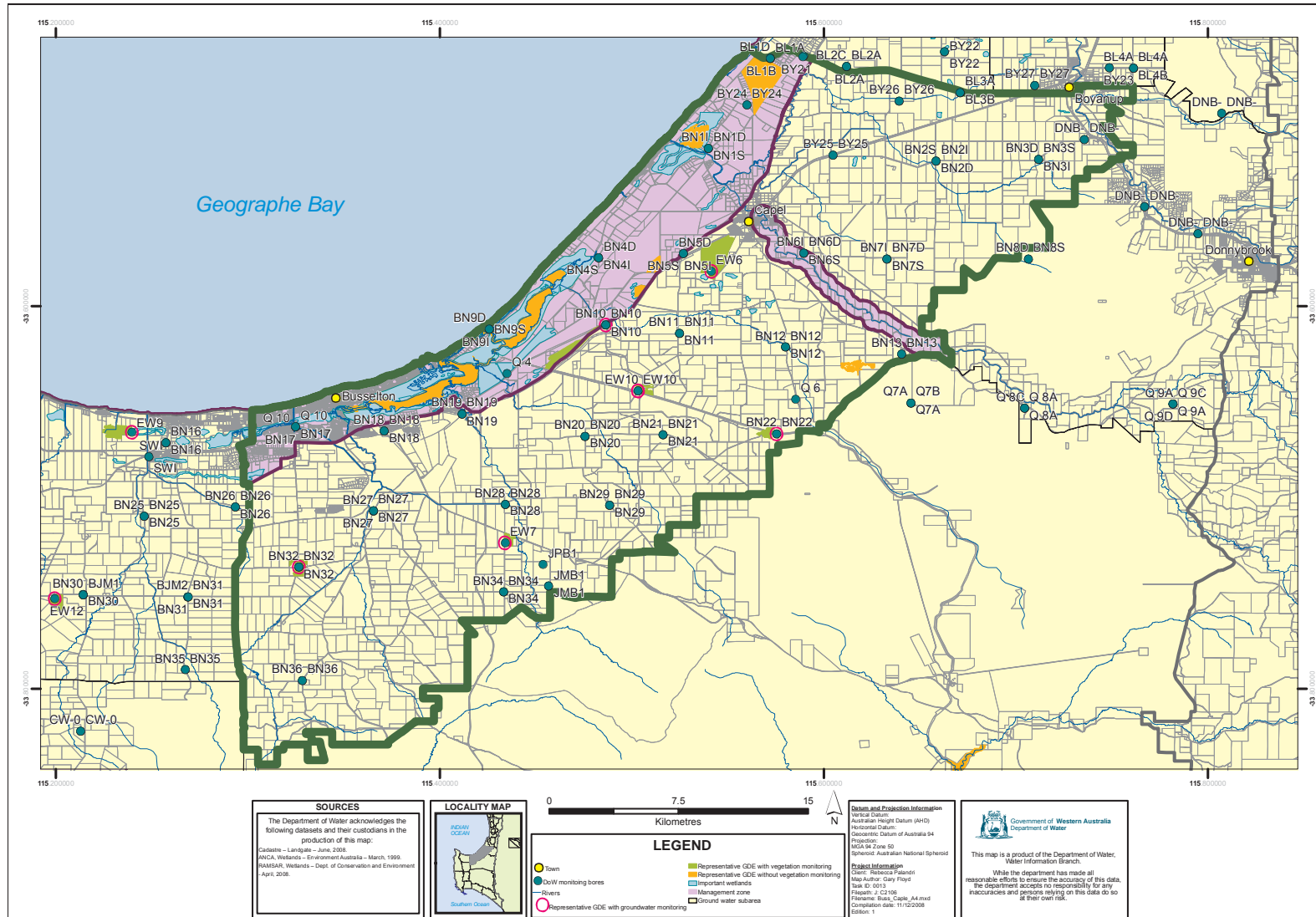
National Parks, reserves and state forest: Tuart Forest National Park, Millbrook, Coolilup and Ludlow state forest reserves; Tutunup road, Ruabon, Capel, Ambergate, Fish road, Sabina, Spanish Settlers and part of Broadwater wetlands nature reserves.

Recreational sites: Most recreational sites are national heritage sites, estates, parks and nature reserves.

Management zones that apply in this subarea

5	Known areas of groundwater baseflow from regional aquifers	Manage groundwater abstraction to avoid impact on groundwater baseflow in the Capel and Brunswick rivers. Does not cover the Margaret and Blackwood rivers (see management zone 8–11).
6	Swan coastal plain wetlands – including Stirling wetlands, Vasse–Wonnerup estuary, wetlands north of Bunbury	Minimise impacts on groundwater dependent ecosystems from abstraction in the underlying aquifers and connected systems. Control the decrease in runoff and changes to drainage from agricultural and urban activities. Control abstraction to minimise impacts on social and ecological sites from regional and local abstraction.

Additional assessment and licensing requirements apply in the areas covered by a management zone. Please refer to Section 5.2 of the *South West groundwater areas allocation plan* for more detail.



SOURCES

The Department of Water acknowledges the following datasets and their custodians in the production of this map:

Cadastre – Landgate – June, 2008
 ANCA Wetlands – Environment Australia – March, 1999
 Ramsar Wetlands – Dept. of Conservation and Environment – April, 2008



LEGEND

- Town
- DoW monitoring bores
- Rivers
- Representative GDE with groundwater monitoring
- Representative GDE with vegetation monitoring
- Representative GDE without vegetation monitoring
- Important wetlands
- Management zone
- Ground water sub-area

Datum and Projection Information

Vertical Datum: Australian Height Datum (AHD)
 Horizontal Datum: Geocentric Datum of Australia 94
 Projection: MGA 94 Zone 50
 Spheroid: Australian National Spheroid

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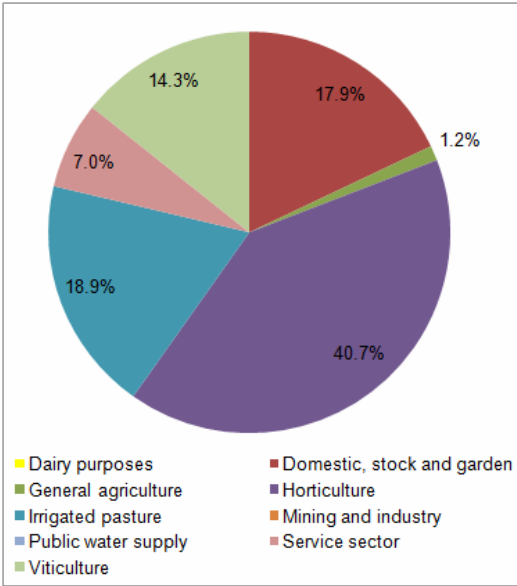
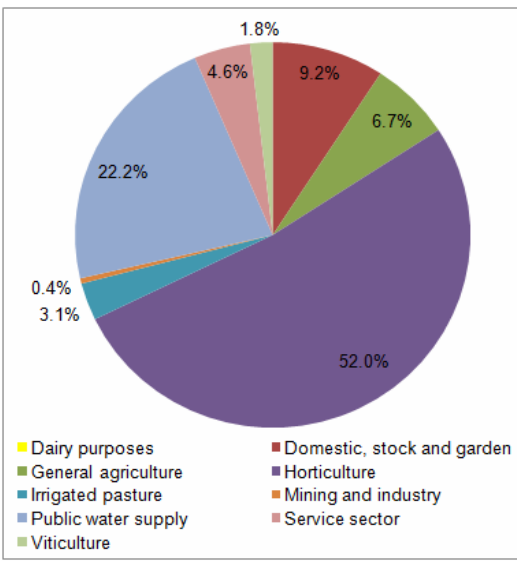
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This map is a product of the Department of Water, Water Information Branch.

While the department has made all reasonable efforts to ensure the accuracy of this data, the department accepts no responsibility for any inaccuracies and persons relying on this data do so at their own risk.

Figure 5 Busselton-Capel subarea

2.3 Donnybrook

Donnybrook		
Subarea description		
Area	207.2 km ²	Licensed water use (November 2008)
Proclamation	Busselton–Capel groundwater area 1984	<p><i>Surficial: 372 040 kL/yr</i></p>  <p><i>Leederville: 2 484 475 kL/yr</i></p> 
Shire	Shire of Donnybrook	
Rainfall	900–1100 mm	
Allocation and water availability kL/yr		
Aquifer	Allocation limit	
Superficial	5 000	Access restricted by location of aquifer. Contact the Busselton office for more information.
Surficial (Blackwood)	495 000	
Leederville	2 400 000	Over allocated. Contact the Busselton office for more information.
Issues for water management		
<p>The Surficial Aquifer is discontinuous across the subarea and access to this aquifer is restricted by its location.</p> <p>The Preston and Capel rivers are used for irrigation in this subarea and require a surface water licence unless accessing a share of Preston Valley Irrigation Co-operative water.</p> <p>The Leederville Aquifer is fully allocated.</p>		
Hydrogeology		
Aquifer	Description	
Surficial	The Surficial Aquifer is limited to areas either side of the Preston River and tributaries, old palaeochannels and small pockets of alluvium. Throughout the rest of the subarea it is thin to absent, with the unconfined Leederville directly below. The water quality is generally fresh.	

Donnybrook			
Leederville	<p>The Leederville formation in this subarea contains the Quindalup member, Upper and Lower Mowen member and Upper and Lower Vasse member. In the east at Donnybrook it overlaps the Darling Fault and is in direct hydraulic connection with the Donnybrook Sandstone.</p> <p>This is a recharge area for the Leederville Aquifer on the Swan coastal plain, providing groundwater throughflow into the Bunbury groundwater area in a north-westerly direction. It thins to the west of the subarea, where the Bunbury Basalt formation is present.</p> <p>The Leederville in this subarea is generally unconfined between the shallow depths of 5–15 m down to approximately 110 m below ground level. From approximately 110–175 m is a shale layer, separating the unconfined section of the Leederville (Quindalup and Upper Mowen members) and the confined section of the Leederville aquifer (Vasse member). Groundwater has low salinity, generally < 500 mg/L.</p>		
Considerations for water use include, but are not limited to, the following			
Ecological			
<p><i>Wetlands and waterways:</i> Capel River, Preston River and Joshua Creek</p> <p><i>Threatened ecological communities and declared rare flora sites:</i> Eight different declared rare flora species across 16 sites with varying levels of protection located in the subarea. They are all located within state forest.</p>			
Cultural			
<p><i>Native Title claimants:</i> South West Boojarah and Gnaala Karla Booja.</p> <p><i>Aboriginal Heritage sites:</i> Fifteen sites including the Ferguson, Capel, Preston, Vasse and Harris rivers, various isolated finds, art and camp sites.</p>			
Social			
<p><i>Towns and localities:</i> Town of Donnybrook is located in this subarea and takes most of its domestic water supply from the shallow Leederville Aquifer. Localities of Donnybrook, The Plains, Paynedale, Argyle, Capel River, Upper Capel, Crooked Brook and Gwindinup cover this subarea with water supply for domestic purposes from rainwater tanks and exempt groundwater abstraction.</p> <p><i>Public water supply:</i> The Water Corporation supplies drinking water for the town of Donnybrook from the Leederville Aquifer.¹</p> <p><i>National Parks, reserves and state forest:</i> Eighty per cent of the subarea is Boyanup and Jarrahwood state forest.</p> <p><i>Recreational sites:</i> State forest and the national estate places.</p>			
Management zones that apply in this subarea			
5	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%; padding: 5px;">Known areas of groundwater baseflow from regional aquifers</td> <td style="padding: 5px;">Manage groundwater abstraction to avoid impact on groundwater baseflow in the Capel and Brunswick rivers. Does not cover the Margaret and Blackwood rivers (see management zone 8–11).</td> </tr> </table>	Known areas of groundwater baseflow from regional aquifers	Manage groundwater abstraction to avoid impact on groundwater baseflow in the Capel and Brunswick rivers. Does not cover the Margaret and Blackwood rivers (see management zone 8–11).
Known areas of groundwater baseflow from regional aquifers	Manage groundwater abstraction to avoid impact on groundwater baseflow in the Capel and Brunswick rivers. Does not cover the Margaret and Blackwood rivers (see management zone 8–11).		
<p>Additional assessment and licensing requirements apply in the areas covered by a management zone. Please refer to Section 5.2 of the <i>South West groundwater areas allocation plan</i> for more detail.</p>			

¹ Water Corporation 2006, *Donnybrook drinking water reserve – drinking water source protection assessment*, Water Corporation, Perth.

Plan companion for the South West groundwater areas allocation plan

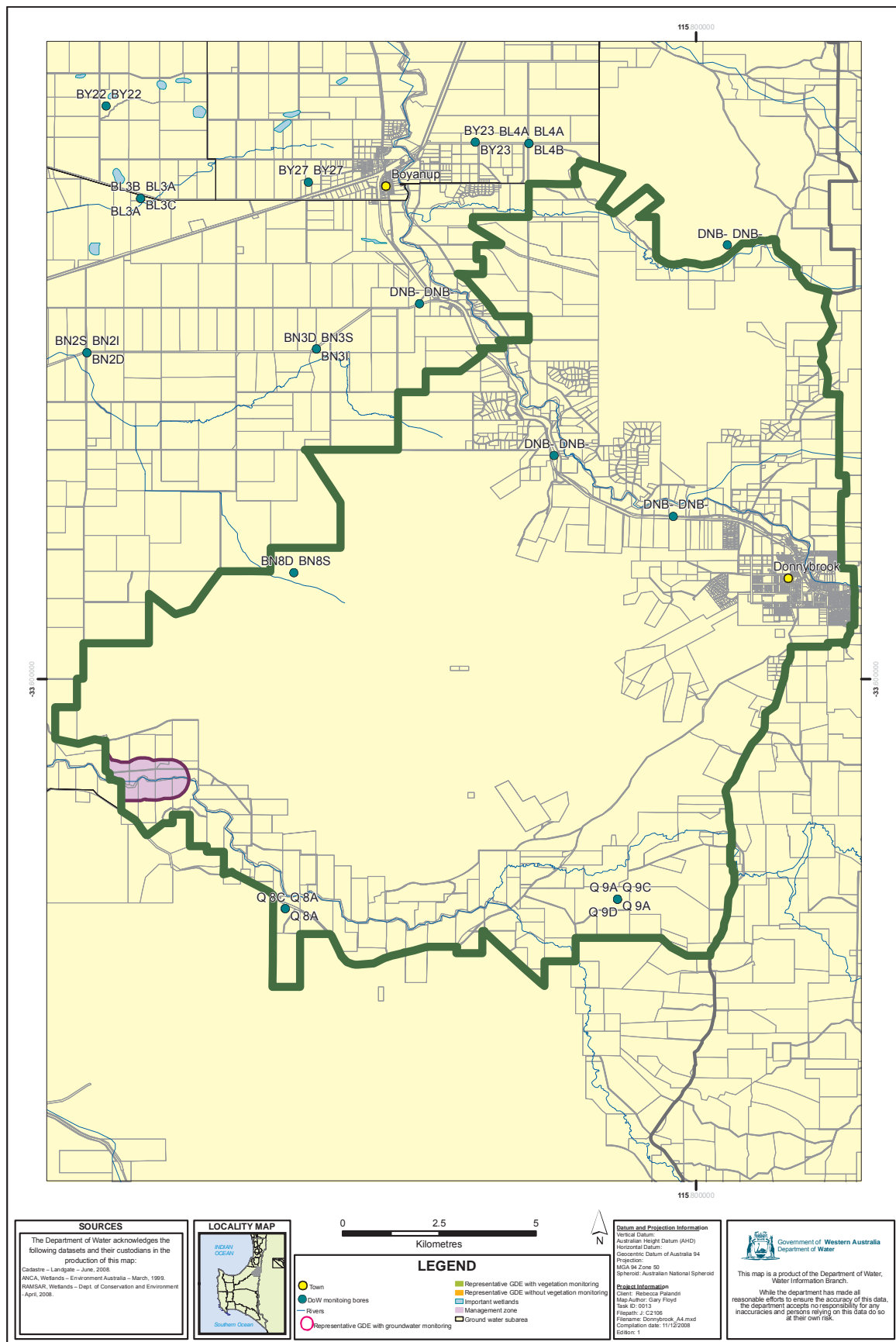


Figure 6 Donnybrook subarea

2.4 Blackwood Plateau North

Blackwood Plateau North		
Subarea description		
Area	1056.9 km ²	
Proclamation	Busselton–Capel groundwater area 1984, varied in 1989	
Shire	Shires of Augusta–Margaret River, Donnybrook, Nannup and Busselton	
Rainfall	900–1100 mm	
Licensed water use (November 2008)	Leederville: 6500 kL/yr Use: Stock, domestic and garden supply (100%)	
Allocation and water availability kL/yr		
Aquifer	Allocation limit	Available water
Superficial	5 000	Access restricted by location of aquifer. Contact the Busselton office for more information.
Surficial (Blackwood)	45 000	
Leederville	250 000	
Issues for water management		
<p>Any new developments requiring larger quantities of groundwater than have been allocated to this subarea are likely to affect developments north on the Swan coastal plain. Because of this any application for water in this area greater than the allocation limit will have to provide sufficient proof that the abstraction is not going to impact outside the subarea and meets the requirements of the plan.</p> <p>See the <i>South West groundwater areas allocation plan</i>, section 5.1 for more detail. Environmental management triggers and responses also apply. See <i>Management triggers and responses for groundwater-dependent ecosystems in the South West groundwater areas</i>, Del Borrello 2008 for more information.</p>		
Hydrogeology		
Aquifer	Description	
Surficial	The Surficial sediments are thin to absent and are generally only present in small pockets along river beds, old palaeochannels and alluvial deposits.	
Leederville	<p>The Leederville Aquifer is a multi-layered aquifer system comprising of discontinuous interbedded sequences of sand and clay. The Leederville Aquifer on the Vasse shelf (between Busselton and Dunsborough faults) includes six distinct members of the Leederville formation – Quindalup, Upper and Lower Mowen, Upper and Lower Vasse and Yelverton members.</p> <p>The subarea covers most of the recharge zone for the Leederville Aquifer (Vasse shelf – along the western boundary and some areas north of the Blackwood River).</p> <p>The aquifer is connected to the base flow of the Margaret River and several tributaries of the Blackwood River. It is thin to absent over the Bunbury Basalt. Groundwater salinity is generally < 500 mg/L.</p>	

Blackwood Plateau North

Considerations for water use include, but are not limited to, the following

Ecological

Wetlands and waterways: The main watercourses are Margaret River main and north branches, Capel River south branch, Rosa Brook (east and west), Sabina River, Abba River, Harrington Brook, Ludlow River, St Paul Brook, St John Brook and Rocky Gully. There are no wetlands of significance in this subarea.

Threatened ecological communities and declared rare flora sites: Over 30 different declared rare flora species across 80 sites which are all located within the state forest areas.

Groundwater-dependent ecosystems and ecological water requirement sites: There are several ecological water requirement sites which do not have departmental monitoring associated with them, but are important and may require additional work if a licence application is submitted near them (see Hyde 2006 for more information).

Cultural

Native Title claimant: South West Boojarah.

Aboriginal Heritage sites: There are numerous sites registered including water related sites of Capel, Abba, Sabina, Blackwood and Margaret rivers (Waugal sites). Barrabup Pool, Cambrey Pool and Workman's Pool are recognised as sites of significance that are not yet registered.

Social

Towns and localities: Localities Jarrahwood, Yognaup, Capel River, Barrabup, Baudin, Gundinup, Upper Capel River and Brazier cover this subarea with water supply for domestic purposes from rainwater tanks and exempt groundwater abstraction.

Public water supply: Part of a the public drinking water source area for the Margaret River and Ten-Mile Brook public water supply,¹ under the *Country Areas Water Supply Act 1947* covers the south-western section of subarea (priority one).

National Parks, reserves and state forest: Ninety per cent of the subarea is Blackwood, Millbrook and Jarrahwood state forest reserves and the Whicher National Park.

Recreational sites: There are several pools on the Margaret River and its tributaries and the Blackwood River tributaries are recreational sites of significance. The proposed conservation parks of St John Brook and Jarrahwood, and watercourse of St John Brook, in particular the freshwater pools of Barrabup and Workman's pool, are also recreational sites of significance.

Management zones that apply in this subarea

8	Discharge and recharge (groundwater) areas of the Blackwood River (including Hut pool, Poison Gully, St John Brook) and Yarragadee outcrop area (recharge zone)	Minimise the potential impacts from regional abstraction which may affect water levels in the recharge area and cause changes to the discharge zones on the Blackwood River and tributaries, affecting associated groundwater-dependent ecosystems. Minimise the potential impact from local abstraction close to the river (downstream of Darradup). Increase monitoring and minimise impacts on the recharge zone from regional abstraction.
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Additional assessment and licensing requirements apply in the areas covered by a management zone. Please refer to Section 5.2 of the *South West groundwater areas allocation plan* for more detail.

¹ Department of Environment 2005, *Margaret River catchment area (including Ten-Mile Brook catchment) drinking water source protection plan*, Water source protection series report no 53, Department of Environment, Government of Western Australia.

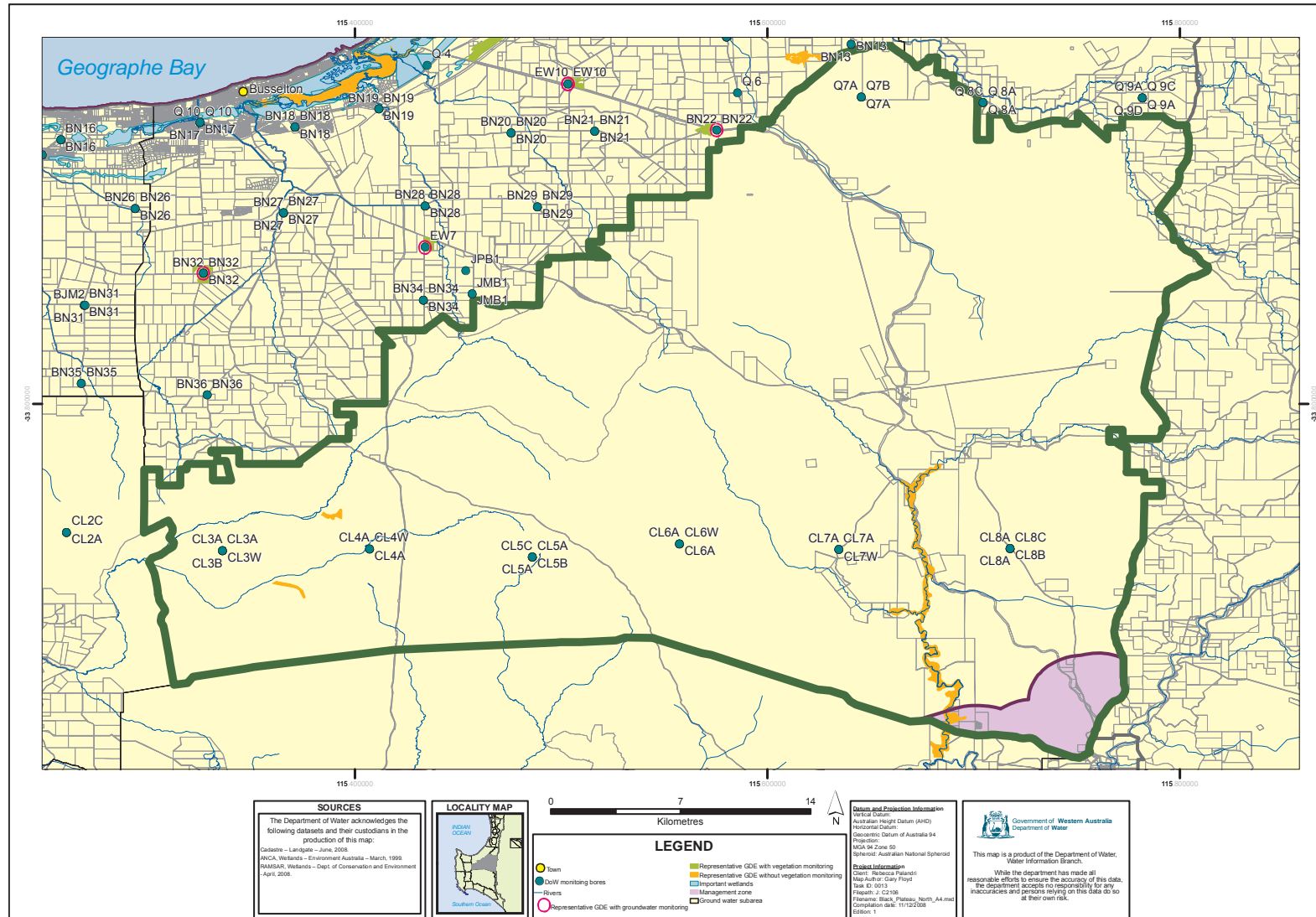


Figure 7 Blackwood Plateau North subarea

2.5 Dunsborough–Vasse

Dunsborough–Vasse																
Subarea description																
Area	302.5 km ²	Licensed water use (November 2008)														
Proclamation	Busselton–Capel groundwater area 1984	<p><i>Superficial and surficial: 3 447 610 kL/yr</i></p> <table border="1"> <caption>Superficial and surficial water use (November 2008)</caption> <thead> <tr> <th>Category</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>Horticulture</td> <td>42.6%</td> </tr> <tr> <td>General agriculture</td> <td>19.8%</td> </tr> <tr> <td>Service sector</td> <td>16.3%</td> </tr> <tr> <td>Domestic, stock and garden</td> <td>11.9%</td> </tr> <tr> <td>Public water supply</td> <td>3.2%</td> </tr> <tr> <td>Dairy purposes</td> <td>1.3%</td> </tr> </tbody> </table>	Category	Percentage	Horticulture	42.6%	General agriculture	19.8%	Service sector	16.3%	Domestic, stock and garden	11.9%	Public water supply	3.2%	Dairy purposes	1.3%
Category	Percentage															
Horticulture	42.6%															
General agriculture	19.8%															
Service sector	16.3%															
Domestic, stock and garden	11.9%															
Public water supply	3.2%															
Dairy purposes	1.3%															
Shire	Shires of Augusta–Margaret River and Busselton															
Rainfall	800–1200 mm															
Allocation and water availability kL/yr																
Aquifer	Allocation limit	Available water														
Superficial	2 500 000	No water available. Contact the Busselton office for more information.														
Surficial (Leeuwin)	1 400 000															
(Blackwood)	600 000															
Leederville	5 400 000															
Issues for water management																
<p>This subarea is fully allocated in the Leederville Aquifer and trading has occurred since 2001. Abstraction on the coast and in the Jindong horticultural area have restrictions (management zones 5 and 6) to maintain water quality. As a result the location and depth of draw points is likely to be restricted. Monitoring of water quality may be included as a licence condition.</p> <p>Environmental management triggers and responses apply. See <i>Management triggers and responses for groundwater-dependent ecosystems in the South West groundwater areas</i>, Del Borrello 2008 for more information.</p> <p>More information on the Leederville and Superficial aquifers can be found in <i>Hydrogeology of the Leederville aquifer in the western Busselton–Capel groundwater area</i>, Schafer, Johnson and Kern, 2008.</p>																
		<p><i>Leederville: 5 413 075 kL/yr</i></p> <table border="1"> <caption>Leederville water use (November 2008)</caption> <thead> <tr> <th>Category</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>Horticulture</td> <td>41.9%</td> </tr> <tr> <td>Public water supply</td> <td>21.8%</td> </tr> <tr> <td>General agriculture</td> <td>15.5%</td> </tr> <tr> <td>Service sector</td> <td>7.7%</td> </tr> <tr> <td>Domestic, stock and garden</td> <td>5.0%</td> </tr> <tr> <td>Dairy purposes</td> <td>1.3%</td> </tr> </tbody> </table>	Category	Percentage	Horticulture	41.9%	Public water supply	21.8%	General agriculture	15.5%	Service sector	7.7%	Domestic, stock and garden	5.0%	Dairy purposes	1.3%
Category	Percentage															
Horticulture	41.9%															
Public water supply	21.8%															
General agriculture	15.5%															
Service sector	7.7%															
Domestic, stock and garden	5.0%															
Dairy purposes	1.3%															

Dunsborough–Vasse	
Hydrogeology	
Aquifer	Description
Superficial	<p>The Superficial Aquifer forms an unconfined aquifer beneath the Swan coastal plain, with a thin saturated thickness of < 5 m. The Superficial formation collectively includes the Tamala Limestone, Bassendean Sand, Guildford formation and Yoganup formation. Consequently there is a large variation in permeability, salinity, recharge rates and soil type. There are areas of high potential acid sulfate soil risk throughout the formation. Soil is predominantly sandy, becoming clayey with increasing lateritic material towards the Whicher Scarp.</p> <p>The depth of the superficial layer decreases towards the Whicher Scarp, where it becomes a thin layer (0–3m) over the laterite, underlain by the Leederville Aquifer. The aquifer is fully recharged and saturated during the winter months resulting in large areas of water logging. However the extensive drainage network captures and diverts most of the excess water. Groundwater salinity ranges from < 1000 mg/L towards the southern and western boundaries and increasing towards the coast to > 1000 mg/L.</p>
Leederville	<p>The Leederville Aquifer is a multi-layered aquifer system consisting of discontinuous interbedded sequences of sand and clay. The Leederville Aquifer on the Vasse shelf (between Busselton and Dunsborough faults) includes six distinct members of the Leederville formation – Quindalup, Upper and Lower Mowen, Upper and Lower Vasse and Yelverton members. The Quindalup member (where present and deep enough) and the Upper Vasse Member are best for abstraction as they have the higher percentage of sand beds.</p> <p>Depth of the aquifer ranges from 15–200 m below ground level (below the Superficial Aquifer) depending on the site location and distance from the coast. Recharge of the aquifer is on the Blackwood Plateau, with some areas of potential recharge from the overlying Superficial Aquifer in areas where the Quindalup member is present beneath the Swan coastal plain. Groundwater salinity increases towards the coast (500–1000 mg/L), with a seawater interface existing at the coast.</p>
Considerations for water use include, but are not limited to, the following	
Ecological	
<p><i>Wetlands and waterways:</i> Seventeen registered environmental protection policy wetlands which are all close to the coast, with the majority linked to the Broadwater wetland system and Toby Inlet, and its associated wetlands. The remaining wetlands are in small groups either side of the Bussell Highway, with the majority located on private land. The Broadwater Wetlands have been modified through the drainage network. The main watercourses are the Buayanyup River and its tributary Dawson Gully, Carburnup River, Station Gully Creek and Mary Brook.</p> <p><i>Threatened ecological communities and declared rare flora sites:</i> Five areas (seventeen sites) where there are registered threatened ecological communities, all of which contain declared rare flora. There are over 15 different species of declared rare flora across over 60 sites. The remaining declared rare flora is located within road reserves, state forest and along the Buayanyup River.</p> <p><i>Groundwater-dependent ecosystems and ecological water requirement sites:</i> There are numerous environmental water requirement sites which do not have departmental monitoring associated with them but are important and may require additional work if a licence application is submitted near them (see Hyde 2006 for more information).</p>	

Dunsborough–Vasse		
Cultural		
<p><i>Native Title claimant:</i> South West Boojarah and the Harris Family.</p> <p><i>Aboriginal Heritage sites:</i> Over 32 registered sites including water related sites such as the Broadwater Farm and associated burial grounds within the wetland area, parts of Vasse Drain and Marybrook.</p>		
Social		
<p><i>Towns and localities:</i> Town of Quininup. The localities of Vasse, Quininup, Ambergate, Abbey, Broadwater, Siesta Park, Kealy, Jindong, Boallia, Kaloorup, Metricup, Yelverton, Yallingup siding, Carunup River, Anniebrook and Dunsborough cover this subarea with water supply for domestic purposes from rainwater tanks and exempt groundwater abstraction.</p> <p><i>Public water supply:</i> The Water Corporation supplies drinking water to the town of Dunsborough and Quindalup from the Sue Coal Measures and Leederville Aquifer. The Busselton Water Board supplies the drinking water for the suburban areas of Abbey Beach, Siesta Park and Broadwater from the Yarragadee aquifer. There is a priority one drinking water source protection area (<i>Country Areas Water Supply Act 1947</i>) covering the bore sites for the Water Corporation bore field (Quindalup water reserve)¹.</p> <p><i>National Parks, reserves and state forest:</i> Locke, Broadwater and Haag Nature Reserves.</p> <p><i>Recreational sites:</i> The nature reserves listed above and Toby Inlet, Broadwater wetlands and the Carunup River.</p>		
Management zones that apply in this subarea		
4	Jindong agricultural area	Manage the current local impacts associated with concentration of draw points in the Leederville Aquifer (water level decline). Reduce abstraction (to allow for aquifer recovery) and encourage spread of draw points (location and depth).
6	Swan coastal plain wetlands – including Stirling wetlands, Vasse-Wonnerup estuary, wetlands north of Bunbury	Minimise impacts on groundwater dependent ecosystems from abstraction in the underlying aquifers and connected systems. Control the decrease in runoff and changes to drainage from agricultural and urban activities. Control abstraction to minimise impacts on social and ecological sites from regional and local abstraction.
Additional assessment and licensing requirements apply in the areas covered by a management zone. Please refer to Section 5.2 of the <i>South West groundwater areas allocation plan</i> for more detail.		

1 Department of Water, 2008, *Quindalup Water Reserve drinking water source protection plan Dunsborough, Yallingup and Quindalup town water supplies*, Water source protection series report no. 88, Department of Water, Government of Western Australia.

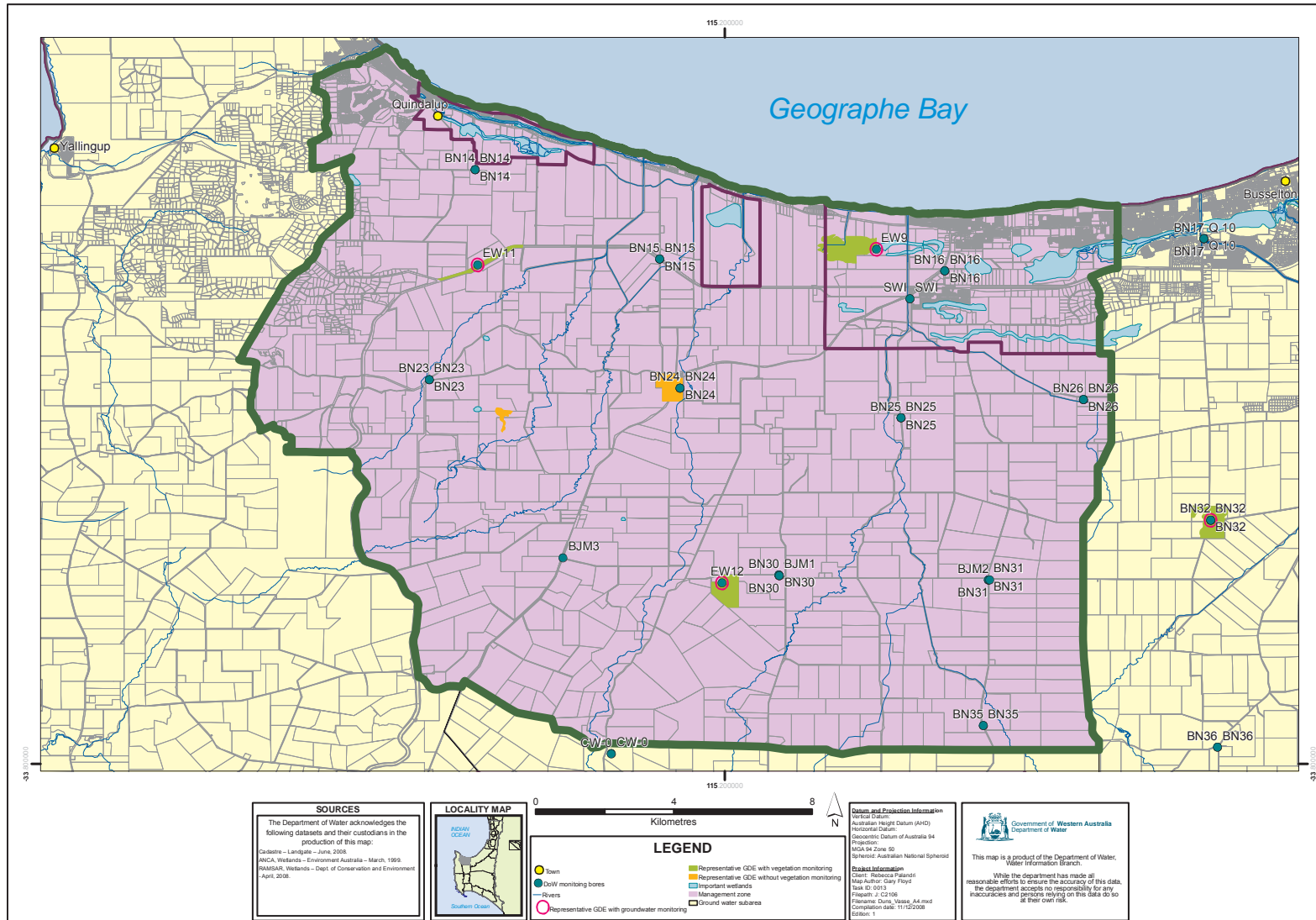


Figure 8 Dunsborough–Vasse subarea

2.6 Cowaramup

Cowaramup																				
Subarea description																				
Area	277.1 km ²	Licensed water use (November 2008)																		
Proclamation	Busselton–Capel groundwater area 1984, varied in 1989	<p><i>Surficial: 615 700 kL/yr</i></p> <table border="1"> <caption>Surficial Water Use (November 2008)</caption> <thead> <tr> <th>Category</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>Dairy purposes</td> <td>0.6%</td> </tr> <tr> <td>Domestic, stock and garden</td> <td>1.3%</td> </tr> <tr> <td>General agriculture</td> <td>35.6%</td> </tr> <tr> <td>Horticulture</td> <td>49.8%</td> </tr> <tr> <td>Irrigated pasture</td> <td>6.6%</td> </tr> <tr> <td>Public water supply</td> <td>0.0%</td> </tr> <tr> <td>Service sector</td> <td>6.6%</td> </tr> <tr> <td>Viticulture</td> <td>0.0%</td> </tr> </tbody> </table>	Category	Percentage	Dairy purposes	0.6%	Domestic, stock and garden	1.3%	General agriculture	35.6%	Horticulture	49.8%	Irrigated pasture	6.6%	Public water supply	0.0%	Service sector	6.6%	Viticulture	0.0%
Category	Percentage																			
Dairy purposes	0.6%																			
Domestic, stock and garden	1.3%																			
General agriculture	35.6%																			
Horticulture	49.8%																			
Irrigated pasture	6.6%																			
Public water supply	0.0%																			
Service sector	6.6%																			
Viticulture	0.0%																			
Shire	Shires of Augusta–Margaret River and Busselton																			
Rainfall	1000–1200 mm																			
Allocation and water availability kL/yr																				
Aquifer	Allocation limit	Available water																		
Surficial (Leeuwin)	895 000	Contact the Busselton office for up-to-date availability.																		
(Blackwood)	5 000																			
Leederville	1 800 000																			
Issues for water management																				
<p>The Surficial and Leederville aquifers are connected to surface water in this subarea. This means that within the boundary of management zone 11 no new bores or excavations are allowed to be constructed into the Leederville Aquifer, other than for exempt use, replacement bores, monitoring purposes or remediation.</p> <p>Any excavation for dam construction will be likely to intercept groundwater and will require a groundwater licence. Restrictions on the location of the draw point and the amount to be abstracted apply (see management zone rules 9–10).</p> <p>More information on the Leederville and Superficial aquifers can be found in <i>Hydrogeology of the Leederville Aquifer in the western Busselton–Capel groundwater area</i>, Schafer, Johnson and Kern, 2008.</p>																				
		<p><i>Leederville: 724 800 kL/yr</i></p> <table border="1"> <caption>Leederville Water Use (November 2008)</caption> <thead> <tr> <th>Category</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>Dairy purposes</td> <td>1.8%</td> </tr> <tr> <td>Domestic, stock and garden</td> <td>1.6%</td> </tr> <tr> <td>General agriculture</td> <td>23.5%</td> </tr> <tr> <td>Horticulture</td> <td>7.0%</td> </tr> <tr> <td>Irrigated pasture</td> <td>64.5%</td> </tr> <tr> <td>Public water supply</td> <td>0.0%</td> </tr> <tr> <td>Service sector</td> <td>1.6%</td> </tr> <tr> <td>Viticulture</td> <td>0.0%</td> </tr> </tbody> </table>	Category	Percentage	Dairy purposes	1.8%	Domestic, stock and garden	1.6%	General agriculture	23.5%	Horticulture	7.0%	Irrigated pasture	64.5%	Public water supply	0.0%	Service sector	1.6%	Viticulture	0.0%
Category	Percentage																			
Dairy purposes	1.8%																			
Domestic, stock and garden	1.6%																			
General agriculture	23.5%																			
Horticulture	7.0%																			
Irrigated pasture	64.5%																			
Public water supply	0.0%																			
Service sector	1.6%																			
Viticulture	0.0%																			

Cowaramup	
Hydrogeology	
Aquifer	Description
Surficial	There are a variety of Surficial deposits throughout the subarea where weathering and erosion of the underlying layer of sediments has occurred. The Surficial Aquifer in this subarea is very thin or absent and is difficult to differentiate between the shallow Leederville Aquifer. The water quality is generally fresh where present.
Leederville	<p>The Leederville Aquifer is a multi-layered aquifer system comprising of discontinuous interbedded sequences of sand and clay. The Leederville aquifer on the Vasse shelf (between Busselton and Dunsborough faults) includes six distinct members of the Leederville formation – Quindalup, Upper and Lower Mowen, Upper and Lower Vasse and Yelverton members.</p> <p>The Quindalup member (where present and deep enough) and the Upper Vasse Member are best for abstraction as they have the higher percentage of sand beds. Depth of the aquifer ranges from 15–200 m below ground level (below the superficial aquifer) depending on the site location and distance from the coast.</p> <p>There is a groundwater divide (flow direction north towards the coast and south towards Margaret River) through the subarea. This flow changes between the layers of the formation and is influenced by the Margaret River, Whicher Scarp, topography and the fault lines.</p> <p>The subarea contains part of the recharge area of the Leederville Aquifer (on the Blackwood Plateau). Groundwater salinity is generally fresh < 500 mg/L and is lowest in the active recharge area (Blackwood Plateau).</p>
Considerations for water use include, but are not limited to, the following	
Ecological	
<p><i>Wetlands and waterways:</i> The main watercourses are Margaret River main branch, Caribunup River, Buayanyup River, Oronstone Gully and Dawson Gully.</p> <p><i>Threatened ecological communities and declared rare flora sites:</i> There are seven registered threatened ecological community sites, including several ironstone communities which are all located in state forest. Over 30 different species (across 60 sites) of declared rare flora of varying levels of protection are located in the subarea. They are all located within state forest.</p>	
Cultural	
<p><i>Native Title claimant:</i> South West Boojarah.</p> <p><i>Aboriginal Heritage sites:</i> The Margaret River is a site of mythological significance (Waugal).</p>	
Social	
<p><i>Towns and localities:</i> Town of Rosa Brook and the localities of Osmington, Metricup, Cowaramup, Bramley, Kaloorup, Boallia, Treeton, Rosa Brook and Rosa Glen cover this subarea with water supply for domestic purposes from rainwater tanks and exempt groundwater abstraction.</p> <p><i>Public water supply:</i> The Water Corporation provides drinking water from the Margaret River Ten–Mile Brook surface water dam to the town site of Rosa Brook.</p> <p>Part of the public drinking water source area for the Margaret River and Ten-Mile Brook public water supply,¹ under the <i>Country Areas Water Supply Act 1947</i>, covers the lower half of the subarea (priority one and three).</p>	

Cowaramup

National Parks, reserves and state forest: Approximately 50% of the subarea is covered by forest; including Blackwood and North East Margaret River state forest reserves and the Rapids conservation park.

Recreational sites: Canebrake Pool and the Upper Reaches of the Margaret River are recreational sites of significance, located within the Blackwood State Forest and Rapids conservation park.

Management zones that apply in this subarea

9	Cowaramup viticultural area	Manage groundwater abstraction to minimise cumulative impacts on the Dunsborough–Vasse subarea.
10	Recharge area for Leederville Aquifer on the Vasse shelf	Manage abstraction in the recharge area of the Leederville Aquifer.
11	Margaret River pools	Restrict the abstraction of groundwater and surface water from the Margaret River pools to maintain river base flows in summer and support the ecology.

Additional assessment and licensing requirements apply in the areas covered by a management zone. Please refer to Section 5.2 of the *South West groundwater areas allocation plan* for more detail.

1 Department of Environment 2005, *Margaret River catchment area (including Ten-Mile Brook catchment) drinking water source protection plan*, Water source protection series report no. 53, Department of Environment, Government of Western Australia.

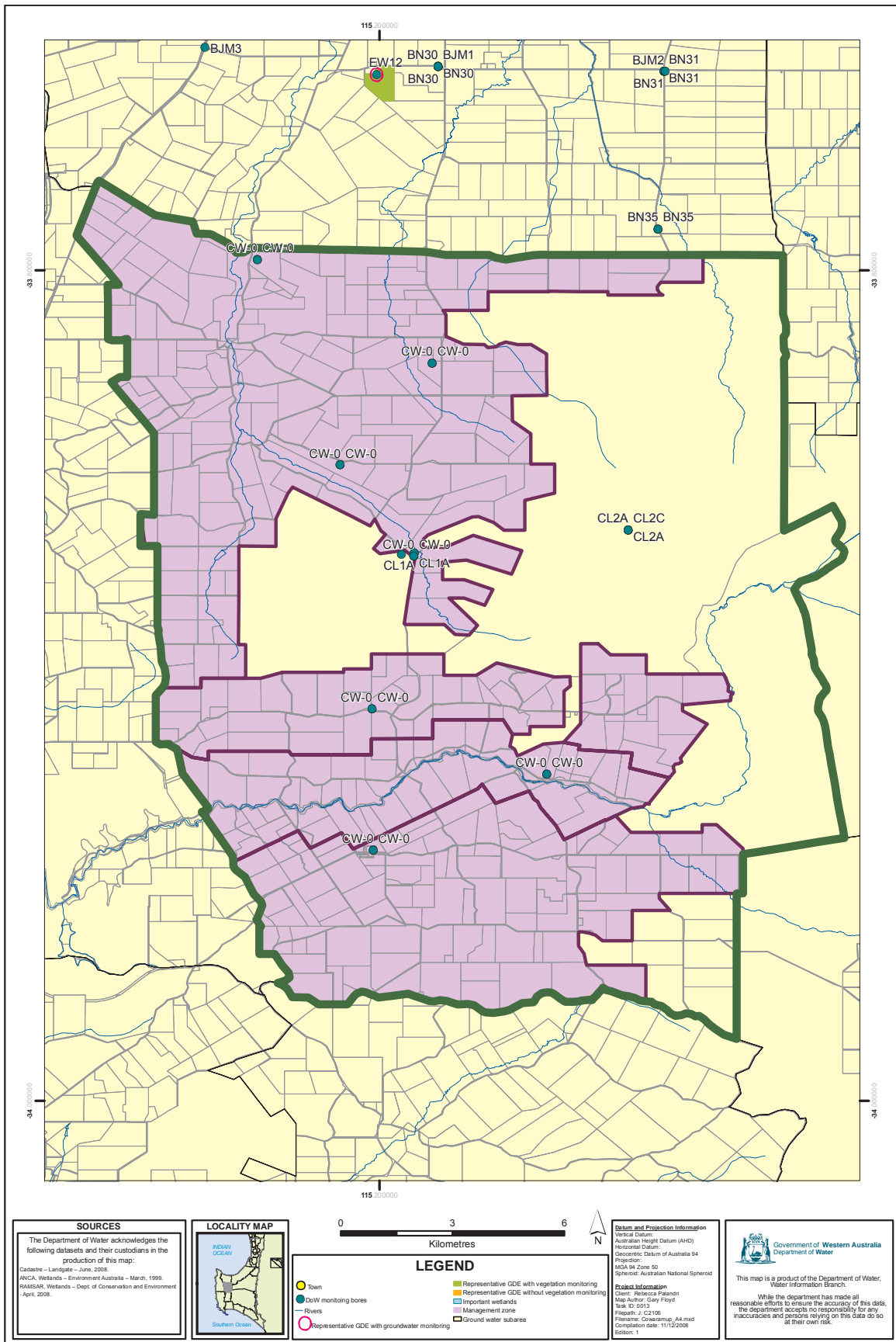


Figure 9 Cowaramup subarea

2.7 Cowaramup–Vasse

Cowaramup–Vasse														
Subarea description														
Area	579.6 km ²	Licensed water use (November 2008)												
Proclamation	Busselton–Capel groundwater area, 1984, varied in 1989	<p><i>Sue Coal Measures</i>: 1 005 000 kL/yr.</p> <table border="1"> <caption>Licensed water use (November 2008)</caption> <thead> <tr> <th>Category</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>Public water supply</td> <td>66.1%</td> </tr> <tr> <td>Mining and industry</td> <td>22.7%</td> </tr> <tr> <td>Viticulture</td> <td>5.5%</td> </tr> <tr> <td>Irrigated pasture</td> <td>3.8%</td> </tr> <tr> <td>Domestic, stock and garden</td> <td>1.8%</td> </tr> </tbody> </table>	Category	Percentage	Public water supply	66.1%	Mining and industry	22.7%	Viticulture	5.5%	Irrigated pasture	3.8%	Domestic, stock and garden	1.8%
Category	Percentage													
Public water supply	66.1%													
Mining and industry	22.7%													
Viticulture	5.5%													
Irrigated pasture	3.8%													
Domestic, stock and garden	1.8%													
Shire	Shire of Augusta–Margaret River													
Rainfall	800–1100 mm													
Allocation and water availability kL/yr														
Aquifer	Allocation limit	Available water												
Sue Coal / Lesueur	4 000 000	Contact the Busselton office for up-to-date availability.												
Issues for water management														
<p>The Sue Coal Measures Aquifer is considered to be a localised aquifer system. Previous groundwater exploration has failed to identify sustainable, long-term groundwater resources. There is only potential for high-yielding bores where a fracture in the sandstone or coal seam is encountered (Schafer <i>et al</i> 2008).</p> <p>There are some areas where the Lesueur Sandstone Aquifer is present. This aquifer is managed together with the Sue Coal Measures Aquifer in this subarea.</p>														
Hydrogeology														
Aquifer	Description													
Sue Coal Measures	<p>The Sue Coal Measures formation is found in the Bunbury Trough, but the aquifer is only accessible on the Vasse Shelf where it is relatively shallow (200–1800 m). Where the formation is present across the rest of the Bunbury trough it is < 2000 m deep, with depth increasing from west to east.</p> <p>The formation is predominantly sandstone, with minor areas of siltstone, shale and coal seams. The Sue Coal Measures is extensively faulted and eroded, with an irregular surface for deposition. It is considered an unreliable resource. The formation is overlain by the Lesueur Sandstone and Sabina Sandstone formations, and the Leederville formations (Mowen, Vasse and Quindalup Members).</p>													

Cowaramup–Vasse	
	<p>The formation has a limited capacity to produce flows required for large scale irrigation due to the dense nature of the lithology, and its unwillingness to give up water readily. The investigations in to groundwater resources from monitoring wells drilled in the area did not encounter large flows.</p> <p>Groundwater allocation in this aquifer is limited by the aquifer’s ability to provide adequate water for certain types of activities.</p>
Considerations for water use include, but are not limited to, the following	
Ecological	
The Sue Coal Measures Aquifer is not known to support any sites of ecological significance.	
Cultural	
The Sue Coal Measures Aquifer is not known to support any sites of cultural significance.	
Social	
<i>Public water supply:</i> The Water Corporation supplies water to Dunsborough from the Sue Coal Measures (in conjunction with the Leederville Aquifer). ¹	
Management zones that apply in this subarea	
No management zones apply to the Sue Coal Measures Aquifer in the Cowaramup–Vasse subarea. The management zones shown in Figure 10 only apply to the Leederville and Surficial aquifers.	

¹ Department of Water 2008, *Quindalup Water Reserve drinking water source protection plan Dunsborough, Yallingup and Quindalup town water supplies*, Water source protection series report no. 88, Department of Water, Government of Western Australia.

Plan companion for the
South West groundwater areas allocation plan

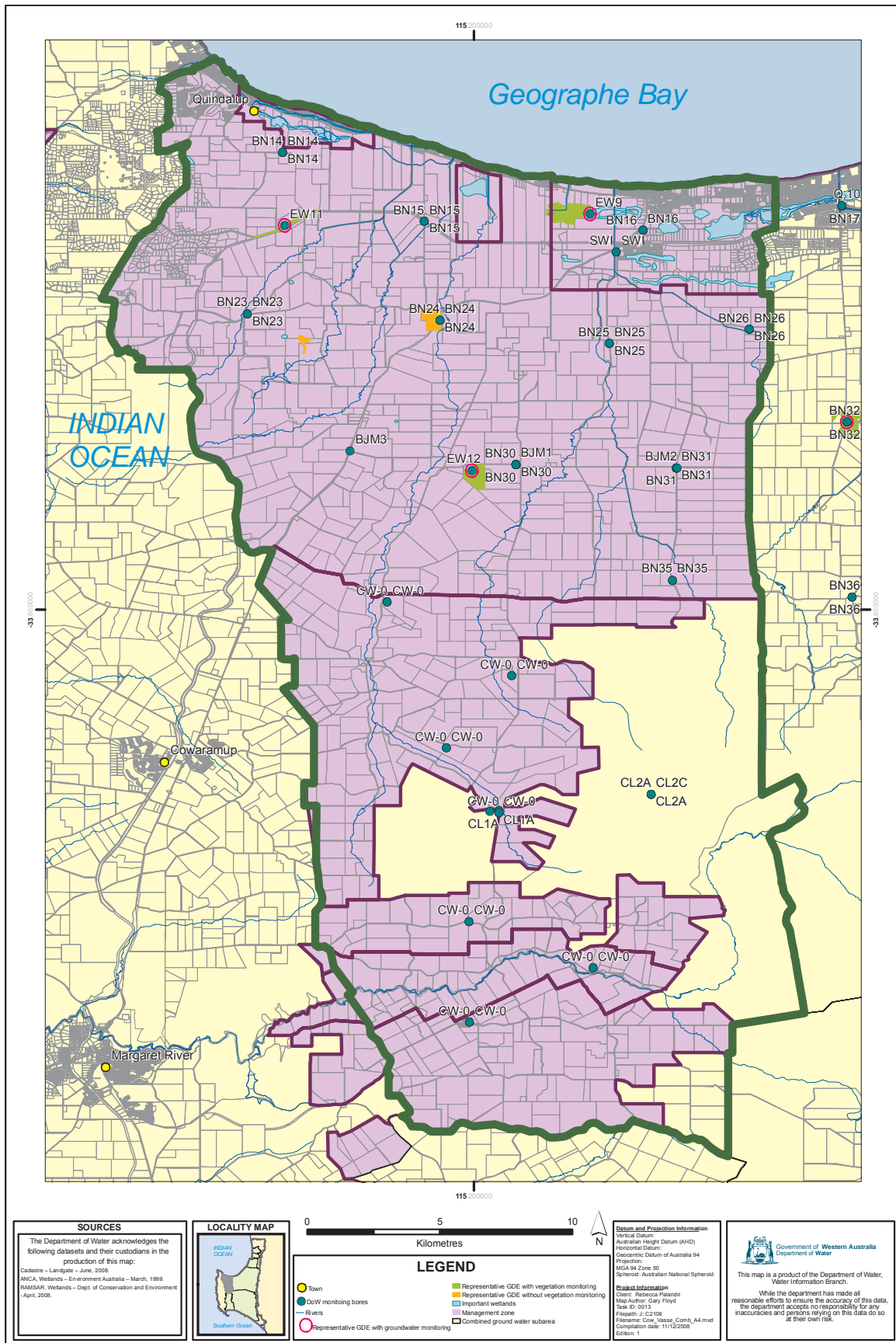
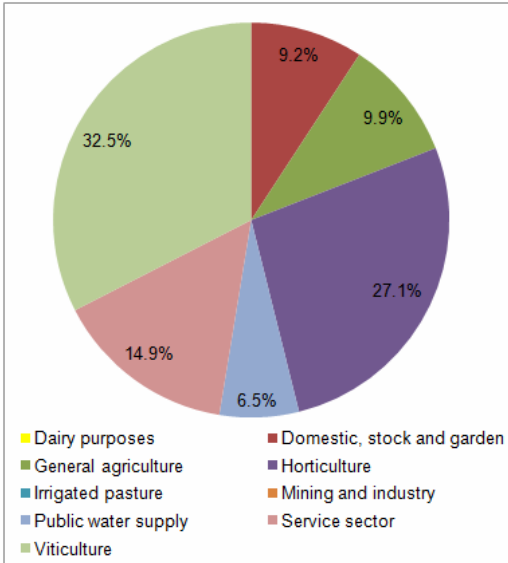
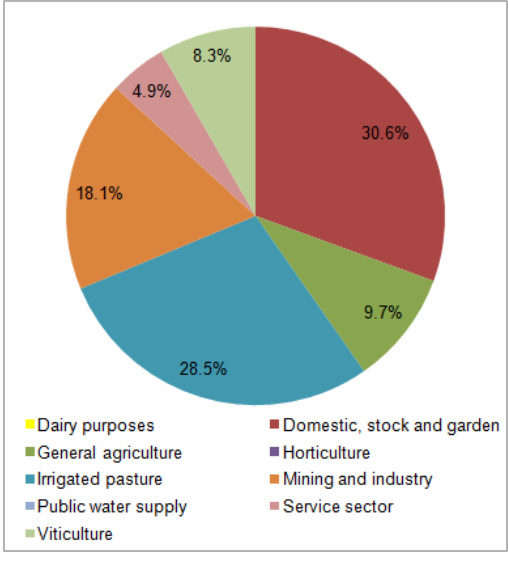


Figure 10 Cowaramup-Vasse subarea

2.8 Cape to Cape North

Cape to Cape North																				
Subarea description																				
Area	530.4 km ²	Licensed water use (November 2008)																		
Proclamation	Busselton–Capel groundwater area – variation 1997	<p><i>Surficial: 428 650 kL/yr</i></p>  <table border="1"> <caption>Surficial Water Use (November 2008)</caption> <thead> <tr> <th>Category</th> <th>Percentage</th> </tr> </thead> <tbody> <tr><td>Dairy purposes</td><td>9.2%</td></tr> <tr><td>General agriculture</td><td>9.9%</td></tr> <tr><td>Horticulture</td><td>27.1%</td></tr> <tr><td>Irrigated pasture</td><td>6.5%</td></tr> <tr><td>Public water supply</td><td>14.9%</td></tr> <tr><td>Mining and industry</td><td>6.5%</td></tr> <tr><td>Service sector</td><td>32.5%</td></tr> <tr><td>Viticulture</td><td>9.9%</td></tr> </tbody> </table>	Category	Percentage	Dairy purposes	9.2%	General agriculture	9.9%	Horticulture	27.1%	Irrigated pasture	6.5%	Public water supply	14.9%	Mining and industry	6.5%	Service sector	32.5%	Viticulture	9.9%
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Viticulture	9.9%																			
Shire	Shires of Augusta–Margaret River and Busselton																			
Rainfall	800–1200 mm																			
Allocation and water availability kL/yr																				
Aquifer	Allocation limit	Available water																		
Surficial (Leeuwin)	900 000	Restricted by location and resource. Contact the Busselton office for more information.																		
Fractured rock	N/A																			
Issues for water management																				
<p>The Surficial and Fractured rock aquifers are limited in their capacity to supply water. There is no guarantee that the supply will be constant. Both aquifers rely on rainfall recharge, as such the allocation limits and the allocation of the water resource are limited. As a result restrictions on the location of excavations and bores may apply.</p> <p>Within the boundary of management zone 12 no new bores or excavations are allowed to be constructed, other than for exempt use, replacement bores, monitoring purposes or remediation.</p> <p>Outside the management zone any new licence application may require hydrogeological investigations, in particular pump tests, which will be required from the point of abstraction before a licence can be issued.</p>																				
<p><i>Fractured rock: 72 000 kL/yr</i></p>  <table border="1"> <caption>Fractured rock Water Use (November 2008)</caption> <thead> <tr> <th>Category</th> <th>Percentage</th> </tr> </thead> <tbody> <tr><td>Dairy purposes</td><td>8.3%</td></tr> <tr><td>General agriculture</td><td>9.7%</td></tr> <tr><td>Horticulture</td><td>30.6%</td></tr> <tr><td>Irrigated pasture</td><td>28.5%</td></tr> <tr><td>Public water supply</td><td>18.1%</td></tr> <tr><td>Mining and industry</td><td>4.9%</td></tr> <tr><td>Service sector</td><td>8.3%</td></tr> <tr><td>Viticulture</td><td>9.7%</td></tr> </tbody> </table>			Category	Percentage	Dairy purposes	8.3%	General agriculture	9.7%	Horticulture	30.6%	Irrigated pasture	28.5%	Public water supply	18.1%	Mining and industry	4.9%	Service sector	8.3%	Viticulture	9.7%
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Hydrogeology																				
Aquifer	Description																			
Surficial	The Surficial Aquifer in the Cape to Cape North subarea ranges from alluvial and colluvial deposits in river valleys to dunes and swales which can reach a thickness exceeding 100 m, but the saturated thickness of the aquifer is small, and in places dune sands lie over dry bedrock with no watertable development. Where present the groundwater is generally fresh.																			

Cape to Cape North	
	The sand and limestone deposits are restricted to a few kilometres along the coast. Bores can reach up to 30 m in depth and remain in the Surficial Aquifer, particularly between the Leeuwin Ridge granitic bedrock and the coastal limestone areas along Caves Road.
Fractured rock	<p>In the east of the subarea the fractured rock is the basement rocks of the Leeuwin Complex, which are granitic with an overlying weathered profile. They are overlain by shallow surficial deposits and in some areas thin unconfined Leederville (north-east of the subarea). Along the western coastline are limestone formations where numerous caves have developed. The caves bottom on basement gneisses, with the limestone and sand deposits on top (up to 100 m deep).</p> <p>In Fractured rock aquifers, the rock body is solid, and groundwater storage and movement can occur only along fractures in the rock, which are usually relatively limited and in most instances are not well connected. There is considerable uncertainty associated with the development of a sustainable groundwater resource from the Fractured rock Aquifer, due to the nature of the aquifer system and irregular recharge from rainfall. Groundwater conditions are highly variable, the yields are generally very low and the salinity reaches as much as 4000 mg/L.</p> <p>The Fractured rock Aquifer is poorly understood. The fractures in the rock are recharged through rainfall and groundwater seepage, which can be fed by nearby surface water streams (seepage down into the fractures), springs and underground streams (which may then discharge into surface water systems).</p> <p>The complex nature of the water flow makes it impossible to predict how a specific fracture is going to behave and as a result there is a high risk that this aquifer will not be able to maintain continued flow rates.</p>
Considerations for water use include, but are not limited to, the following	
Ecological	
<p><i>Wetlands and waterways:</i> Margaret River is the major river running through the subarea with Gonyulgup, Bramley, Yallingup, Wilyabrup, Ellen, Cowaramup, Mary, Quininup and Biljedup brooks also present.</p> <p><i>Threatened ecological communities and declared rare flora sites:</i> There are many areas containing threatened ecological communities and declared rare flora, with Meelup and Dunsborough the two main areas. These are situated on the north coastal area of the Naturaliste Ridge along the coastline.</p> <p>Over 30 different species of declared rare flora are present across over 120 sites. They are mainly found in the Leeuwin Naturaliste ridge park, State Forest, crown land or within road/rail reserves.</p> <p>The declared rare fauna species Capel Leeuwin freshwater snail (<i>Austroassiminea lethra</i>) can be found in this subarea.</p>	
Cultural	
<p><i>Native Title claimant:</i> South West Boojarah and the Harris Family.</p> <p><i>Aboriginal Heritage sites:</i> Over 80 registered sites, which include water related sites such as caves, natural land and water sites (including dam sites) and the Margaret River (Waugal).</p>	

Cape to Cape North

Social

Towns and localities: The towns of Cowaramup, Margaret River, Yallingup and Gracetown. The localities of Gracetown, Yallingup Siding, Yallingup, Eagle Bay, Naturaliste, Yelverton, Margaret River, Rosa Brook, Quedjinup, Bramley, Burnside, Cowaramup, Metricup, Wilyabrup, Quindalup and Dunsborough cover this subarea with water supply for domestic purposes from rainwater tanks and exempt groundwater abstraction.

Public water supply: The Water Corporation supplies drinking water for the towns of Cowaramup and Margaret River from the Margaret River Ten-Mile Brook surface water dam. Gracetown has its own drinking water supply from rainwater and some small bores. Yallingup is supplied with drinking water from the Water Corporation’s Quindalup borefield in the Dunsborough–Vasse subarea¹. Part of the public drinking water source area for the Margaret River and Ten-Mile Brook public water supply², under the *Country Areas Water Supply Act 1947* covers a portion of the subarea in the south (priority one and three).

National Parks, reserves and state forest: Leeuwin–Naturaliste Ridge, Yelverton and Bramley National Parks and the nature reserve of Walburra.

Recreational sites: Many national heritage, parks, estates and reserves are areas of recreational significance, particularly the Leeuwin Naturaliste National Park.

Management zones that apply in this subarea

11	Margaret River pools	Restrict the abstraction of groundwater and surface water from the Margaret River pools to maintain river base flows in summer and support the ecology.
12	Cave systems and coastal vegetation	Manage the potential connected cave and vegetation communities dependent on groundwater from fractured rock and surficial sediments.

Additional assessment and licensing requirements apply in the areas covered by a management zone. Please refer to Section 5.2 of the *South West groundwater areas allocation plan* for more detail.

- 1 Department of Water 2008, *Quindalup Water Reserve drinking water source protection plan Dunsborough, Yallingup and Quindalup town water supplies*, Water source protection series report no. 88, Department of Water, Government of Western Australia.
- 2 Department of Environment 2005, *Margaret River catchment area (including Ten-Mile Brook catchment) drinking water source protection plan*, Water source protection series report no. 53, Department of Environment, Government of Western Australia.

Plan companion for the
South West groundwater areas allocation plan

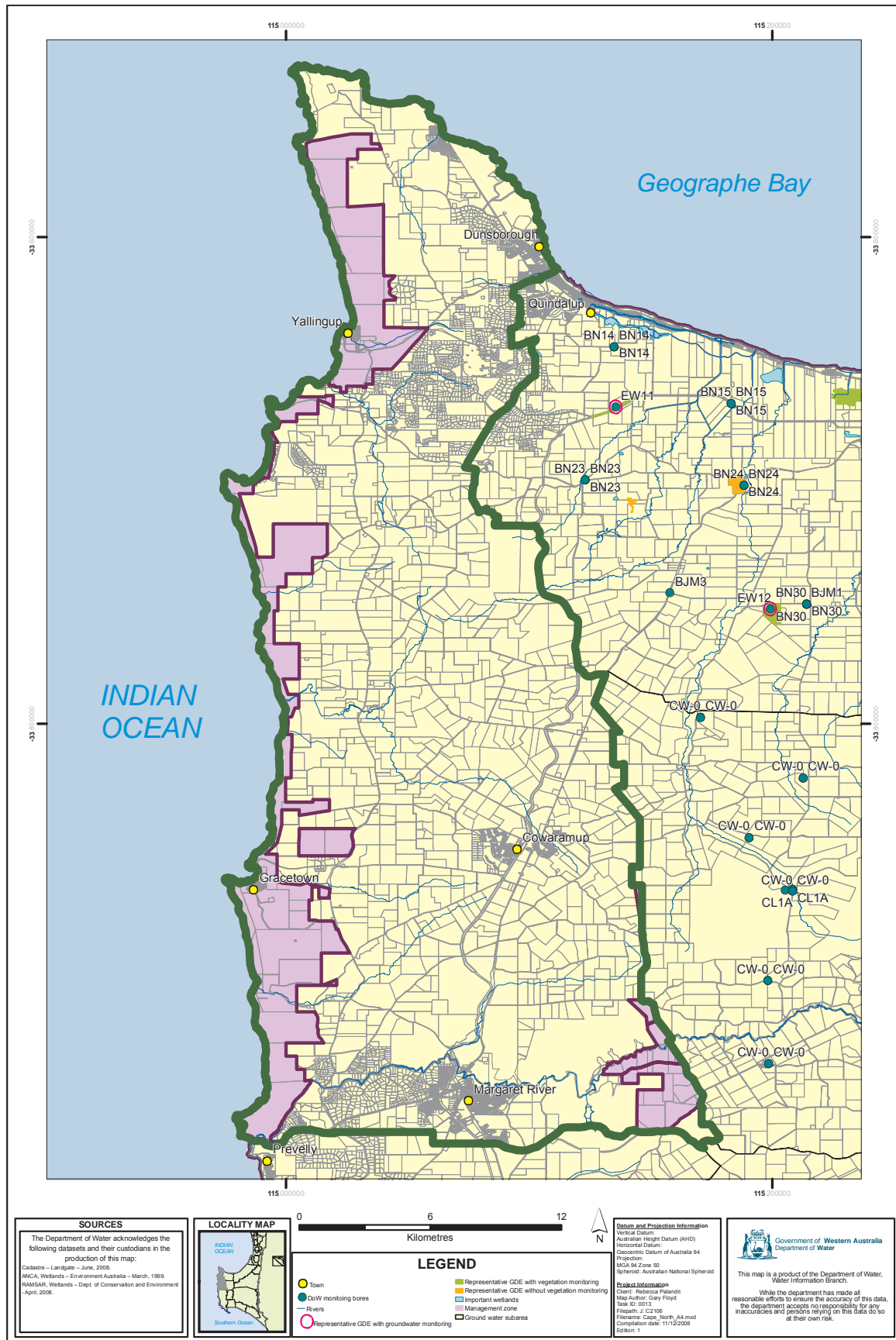


Figure 11 Cape to Cape North subarea

Appendices

Appendix A Statewide licensing policies

Policy name	Brief description
<i>Statewide policy no. 2 – Pesticide use in public drinking water source area</i>	Provides the department's position on the use of pesticides within proclaimed public drinking water source areas.
<i>Statewide policy no. 3 – Policy statement on water sharing</i>	Provides guidance on the overall policy approach to sharing water between competing users.
<i>Statewide policy no. 5 – Environmental water provisions policy for Western Australia</i>	Outlines the department's approach on ensuring that the water needs of the environment are addressed in water allocation decision-making.
<i>Statewide policy no. 6 – Transferable (tradeable) water entitlements for Western Australia</i>	Provides guidance on the transfer and trade of water licences.
<i>Statewide policy no. 8 – Giving an undertaking to grant a licence or a permit under the Rights In Water and Irrigation Act 1914</i>	Defines the circumstances under which the department will give undertakings for the granting of licences to take water, the approval of agreements with respect to water entitlements, permits to interfere with a water course or licences to construct a well.
<i>Statewide policy no. 9 – Water licensing – staged developments</i>	Describes the licensing policy and process used for developments and land uses with a prolonged establishment phase, where water requirements will alter significantly during the life of the project.
<i>Statewide policy no. 10 – Use of operating strategies in the water licensing process</i>	Provides guidance on the structure of operating strategies and on the circumstances and purposes under which they are requested.
<i>Statewide policy no. 11 – Management of unused licensed water entitlements</i>	Outlines how to manage licence allocations to ensure that reducing unused allocations to a minimum effectively uses the water resources.
<i>Draft statewide policy no. 14 – Managing unlicensed groundwater use</i>	Provides the department's position on managing groundwater taken by unlicensed users.
<i>Statewide policy no. 16 – Water conservation and efficiency plans</i>	Provides direction on preparing water conservation and efficiency plans required by water users as part of the water licensing process.
<i>Statewide policy no. 17 – Timely submissions of required further information</i>	Describes the department's policy on the timeframes for submission of further information that is required in the licence assessment process.
<i>Statewide policy no. 19 – Hydrogeological reporting associated with a groundwater well licence.</i>	Provides guidance on when hydrogeological assessments and groundwater monitoring reports are required and the information that they should contain.

All statewide policies are available on the department's website <www.water.wa.gov.au> Managing our water > Statewide policies>.

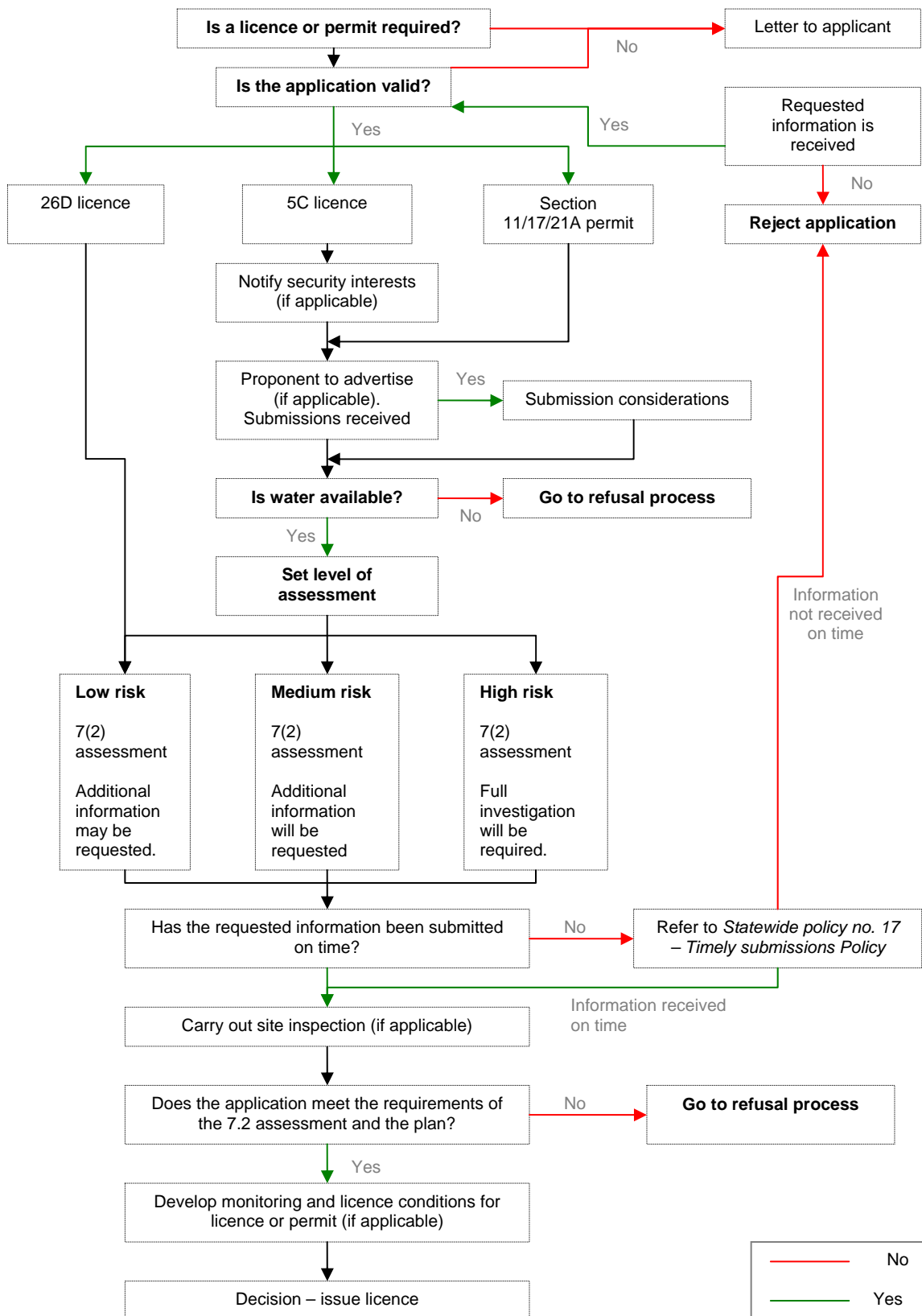


Figure A1 Standard licensing process flowchart

7(2) assessments and groundwater licensing

The Department of Water assesses individual licence applications to construct a bore (26D) and to take water (5C licence) under Schedule 1, Division 2, clause 7(2) of the *Rights in Water and Irrigation Act, 1914*. The level of assessment will vary depending on the level of risk to the environment and existing users. Table 1 provides a brief summary of the clause 7 (2) assessment process with regard to a groundwater licence application (5C and 26D) and what the department considers against each of the requirements under clause 7 (2).

Table A1 Clause 7(2) assessment process for groundwater licensing

Relevant consideration under clause 7(2)		What the department considers
7(2)(a)	<p>Public interest</p> <p>Does the proposal have any economic, social or recreational benefits to the public?</p> <p>This is assessed from a regional or state-wide point of view.</p>	<ul style="list-style-type: none"> • social benefit (including water for community parks and gardens) • recreational benefit (including aesthetics of a natural system, camping, fishing) • economic benefit (including regional development, prospective employment) • advertising of proposals under <i>Rights in Water and Irrigation Act, 1914</i> which provides information to assess public interest
<p>Sustainability assessment</p> <p>A sustainability assessment considers economic, social and ecological factors together and attempts to satisfy as many factors as possible, with minimal trade-offs, applying the principles below:</p> <ul style="list-style-type: none"> • long-term economic health • equity and human rights • biodiversity and ecological integrity. 		
7(2)(b)	<p>Ecologically sustainable</p>	<ul style="list-style-type: none"> • water availability • requirements of relevant allocation plan • hydrogeological assessment • impact on any ecologically significant sites • an assessment is made on the requirements to protect the ecology: <ul style="list-style-type: none"> – monitoring as part of the licensing conditions – an operating strategy – nutrient impact or irrigation development assessment – a water conservation/efficiency plan – a water quality assessment • clearing approval requirements • land capability assessment

Relevant consideration under clause 7(2)	What the department considers
<p>7(2)(c) Environmentally acceptable Can the economic, social and ecological considerations be satisfied? If not, are the impacts acceptable?</p> <p>Economic Long-term economic health Recognise needs of current and future demand</p> <p>Social Equity and human rights</p> <p>Ecological Biodiversity and ecological integrity</p>	<ul style="list-style-type: none"> • any economic values identified through allocation planning • categorisation of economic status: public–commercial or non-commercial, or private–commercial or non-commercial • economic benefit to local, regional or state market • any social and recreational values identified through allocation planning: <ul style="list-style-type: none"> – cultural and heritage considerations: <ul style="list-style-type: none"> – Aboriginal sites of significance – Native title claims • Australian heritage listings • social and recreational benefits or liabilities (including fishing) • findings of the 7(2) (b) assessments
<p>7(2)(d) May prejudice other current and future needs for water The regional view</p>	<ul style="list-style-type: none"> • hydrogeological assessment – effects on current and future needs for water and possible environmental impacts on surrounding areas
<p>7(2)(e) Detrimental effect on another person The local view</p>	<ul style="list-style-type: none"> • need for advertising process • need for an operating strategy • hydrogeological assessment (impact on existing use)
<p>7(2)(f) Could be provided for by another source Assessment considers alternative options and sources</p>	<ul style="list-style-type: none"> • most appropriate resource – hydrogeological assessment and water availability • availability of other sources such as surface water, recycled water, scheme water • most economically viable source
<p>7(2)(g) Are in keeping with: (i) Local practices Local practices and planning requirements</p>	<ul style="list-style-type: none"> • local government authority approval and/or compatible with current land use zoning • application has other relevant government approvals including: <ul style="list-style-type: none"> – Department of Agriculture and Food – Department of Mines and Petroleum – Department of State Development

Relevant consideration under clause 7(2)		What the department considers
		<ul style="list-style-type: none"> – Department for Planning and Infrastructure – Western Australian Planning Commission – Department of Environment and Conservation. • common practice within the local area
7(2)(g) cont.	(ii) Relevant local by-law	<ul style="list-style-type: none"> • by-laws under <i>Rights in Water and Irrigation Act, 1914</i> or <i>Environmental Protection Act 1986</i> – there are none at present in the South West groundwater areas
	(iii) Plan approved under Part III Division 3d Subdivision 2	<ul style="list-style-type: none"> • meets the requirements of the plan approved under Part III Division 3d Subdivision 2 (statutory)
	(iv) Relevant previous decisions of the department	<ul style="list-style-type: none"> • departmental policies and plans • previous licensing decisions where relevant
7(2)(h)	Are consistent with: (i) Land use planning Instruments	<ul style="list-style-type: none"> • application is consistent with Environmental Protection (Clearing of Native Vegetation) Regulations 2004 • local government approval • Western Australian Planning Commission approval • other relevant planning and scheme text.
	(ii) The requirements and policies of other government agencies Issue of a licence cannot pre-empt approvals under the <i>Native Title Act 1993</i> and Part V of the <i>Environmental Protection Act, 1986</i> .	<ul style="list-style-type: none"> • department refers proposal to other government departments, where appropriate
	(iii) Any inter-governmental agreement or arrangement	<ul style="list-style-type: none"> • related inter-governmental agreements or arrangements (such as State Development Acts)

Appendix B Other plans and strategies to be considered

Plan	Consideration	Agency
<i>State water plan</i>	Strategic direction	DoW
<i>South West regional water plan</i>	Strategic direction, South West community issues, principles and issues that guide subordinate plans	DoW
<i>Whicher area surface water allocation plan</i>	Surface water management plan for the majority of the plan area	DoW
<i>Better managing the urban water cycle – the urban drainage initiative</i>	Urban water drainage and management for better urban design.	DoW
<i>Better urban water management</i>	Urban water management for public services and urban design	DPI
<i>Donnybrook water reserve drinking water source protection assessment</i>	Manages land and water use activities in this area to ensure safe drinking water quality	DoW
<i>Quindalup water reserve drinking water source protection plan</i>	Manages land and water use activities in this area to ensure safe drinking water quality	DoW
<i>Leeuwin Springs and Fisher Road wellfield water reserve drinking water source protection plan</i>	Manages land and water use activities in this area to ensure safe drinking water quality	DoW
<i>Margaret River catchment area (including Ten Mile Brook catchment area) drinking water source protection plan</i>	Manages land and water use activities in this area to ensure safe drinking water quality	DoW
<i>South West natural resource management strategy</i>	Natural resource planning and management	SWCC
<i>Busselton wetlands conservation strategy</i>	Land use and environmental management in wetland areas	WAPC and DEC
<i>Augusta-Walpole coastal strategy</i>	Planning scheme for land use and zoning	WAPC
<i>Leeuwin-Naturaliste Ridge statement of planning policy report</i>	Land use change and planning	WAPC
<i>The Geographe catchment management strategy: a report for the Geographe Catchment Council</i>	Natural resource management and planning in the Geographe Bay catchment area	DoW
<i>A water quality improvement plan for Vasse–Wonnerup wetlands and Geographe Bay catchment</i>	Water quality improvement information for nutrient control, drainage and waterways.	DoW

DEC = Department of Environment and Conservation

DPI = Department of Planning and Infrastructure

SWCC = South West Catchments Council

DoW = Department of Water

WAPC = Western Australian Planning Commission

Major legislation relating to water resource management in the South West

Commonwealth legislation:

- *Environmental Protection and Biodiversity Conservation Act 1999*
- *National Water Commission Act 2004*
- *Natural Heritage Trust Act of Australia 1997*
- *National Environmental Protection Council Act 1994*
- *Aboriginal and Torres Strait Islander Heritage Protection Act 1984*
- *World Heritage Properties Conservation Act 1995.*

State legislation:

- *Conservation and Land Management Act 1984*
- *Native Title (State Provisions) Act 1999*
- *Aboriginal Heritage Act 1972*
- *Country Areas Water Supply Act 1947*
- *Environmental Protection Act 1986, amendment 1998*
- *Environmental Protection Regulations 1987*
- *Heritage of Western Australia Act 1990*
- *Metropolitan Water Supply, Sewerage and Drainage Act 1909 (including by-laws)*
- *National Trust of Australia (WA) Act 1964*
- *Rights in Water and Irrigation Act 1914, Regulations 2000*
- *Water Agencies (Powers) Act 1984*
- *Soil and Land Conservation Act 1945, Regulations 1992*
- *Town Planning and Development Act 1928*
- *Water and Rivers Commission Act 1995*
- *Waterways Conservation Act 1976*
- *Western Australian Planning Commission Act 1985*
- *Wildlife Conservation Act 1950, Regulations 1970*
- *Pollution of Waters by Oil and Noxious Substances Act 1987*
- *Contaminated Sites Act 2003.*

Other documents to consider

River Action Plans (Geocatch):

- *Capel River Action Plan 1999*
- *Carbunup River Action Plan 2000*
- *Ellen Brook River Action Plan 2005*
- *Gunyulgup Brook Action Plan 2005*
- *Margaret River Action Plan 2003*
- *River Action Plan for the Sabina, Abba and Ludlow Rivers 2002*
- *River Action Plan for the Cape Naturaliste Streams 2006*
- *River Action Plan for the Gynudup Brook and Tren Creek 2004*
- *Vasse River Action Plan 2000*
- *Yallingup Brook Action Plan 1999.*

National Parks management plans (Department of Environment and Conservation):

- *Leeuwin–Naturaliste National Park 1989*
- *Draft Tuart Forest conservation and management strategy 2006*
- *Draft Parks of the Leeuwin–Naturaliste Ridge, Scott National Park and Gingilup Swamps nature reserve, 2008*

Appendix C Useful information and websites for other government departments

Government department	Website	Contact for more information on:
Department of Environment and Conservation	< www.dec.wa.gov.au >	Acid sulfate soils and contaminated sites. Vegetation clearing and declared rare flora, fauna and threatened ecological sites. Environmental protection policy wetlands. National Park management.
Environmental Protection Authority	< www.epa.wa.gov.au >	EPA approvals and processes
Department of Environment and Heritage	< www.deh.gov.au >	Information and approvals under the <i>Environmental Protection and Biodiversity Conservation Act 1999</i>
Department of Agriculture and Food	< www.dafwa.wa.gov.au >	Best management practices and information on agriculture and food
Bureau of Meteorology	< www.bom.wa.gov.au >	Rainfall, evaporation and climate related information
Department of Mines and Petroleum	< www.dmp.wa.gov.au >	Mining tenements, best-management practices and approvals
Geological Survey of Western Australia		Geological survey maps and reports
Department of State Development	< www.dsd.wa.gov.au >	State agreement Acts and state developments
Department for Planning and Infrastructure	< www.dpi.wa.gov.au >	Cadastral information, land planning information
Western Australian Planning Commission	< www.wapc.wa.gov.au >	Planning and land use development approvals
Department of Fisheries	< www.fish.wa.gov.au >	Aquaculture
Forestry Products Commission	< www.fpc.wa.gov.au >	Plantations
Department of Indigenous Affairs	< www.dia.wa.gov.au >	Aboriginal heritage sites
Office of Native Title	< www.nativetitle.wa.gov.au >	Native title determination
Heritage Council of Western Australia	< www.heritage.wa.gov.au >	Heritage sites
Office of Development Approvals Coordination	< www.odac.dpc.wa.gov.au >	Full list of approvals processes for every government agency
State land information platform (SLIP)	< www.slip.wa.gov.au >	Public mapping information for government agencies

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	The volume of water that can be abstracted for consumptive uses each year from a water resource with acceptable impacts.
aquifer	A geological formation or group of formations capable of receiving, storing and transmitting large quantities of water.
artesian aquifer	A confined aquifer in which the hydraulic pressure will cause water to rise in a bore or spring above the land surface. If the pressure is insufficient to cause the well to flow at the surface, it is called a sub-artesian aquifer.
base flow	The component of stream flow 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 <i>the Rights In Water and Irrigation Act 1914</i> .
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.
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.
ecological water requirements	The water regime needed to maintain ecological values of water-dependent ecosystems at a low level of risk.
environmental water provisions	The water regimes that are provided as a result of the water allocation decision-making process taking into account ecological, social, cultural and economic impacts. They may meet in part or in full the ecological water requirements
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.
groundwater	The water that occurs in pore spaces and fractures in rocks beneath the ground surface. See <i>also</i> aquifer, confined aquifer and unconfined aquifer.
groundwater area	An area proclaimed under the <i>Rights in Water and Irrigation Act 1914</i> for the purposes of licensing and managing water use.
groundwater-dependent ecosystem	An ecosystem that is dependent on groundwater for its existence and health.
hydrogeology	The hydrological and geological science concerned with the occurrence, distribution, quality and movement of groundwater, especially relating to the distribution of aquifers, groundwater flow and groundwater quality.

licence (5C)	A formal permit which entitles the licence holder to ‘take’ water from a watercourse, wetland or underground source.
m AHD	Australian Height Datum – height in metres above Mean Sea Level + 0.026m at Fremantle.
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.
public water supply reserve	Reservation of a volume of water to supply drinking water for human consumption.
recharge	Water that infiltrates into the soil to replenish an aquifer
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).
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.
stock bore	A bore that provides drinking water for stock.
subarea	A smaller area determined by the Department of Water within a proclaimed area used for water allocation planning and management purposes. The boundaries of which are based on the location of the water resource.
surface water	Water flowing over or held in streams, rivers and wetlands on the surface of the land.
throughflow	The flow of water within an, and between, aquifers.
unconfined aquifer	Is the aquifer nearest the surface, having no overlying confining layer. The upper surface of the groundwater within the aquifer is called the watertable. The aquifer contains water with no upper non-porous material to limit its volume or to exert pressure.
unconformity	A discontinuity in rock sequence indicating interruption of sedimentation, commonly accompanied by erosion of rocks below the break or the interface between such strata.
water efficiency	The minimisation of water use through adoption of best management practices.
water reserve	An area proclaimed under the <i>Metropolitan Water Supply Sewerage and Drainage Act 1909</i> or <i>Country Areas Water Supply Act 1947</i> to allow the protection and use of water on or under the land for public water supplies.
watertable	The saturated water level of the unconfined aquifer. Wetlands in low-lying areas are often seasonal or permanent surface expressions of the watertable.

wetland	For the purposes of this plan (unless otherwise specified) the department adopts the Ramsar Convention definition of a wetland as <i>an area that is permanently, seasonally or intermittently waterlogged or inundated with water that may be fresh, saline, flowing or static, including areas of marine water of which the depth at low tide does not exceed 6 metres.</i>
yield	The volume of water that may be drawn from a well or water supply system measured in cubic metres per day, gigalitres per year, or equivalent

Volumes of water

One litre	1 litre	1 litre	(L)
One thousand litres	1000 litres	1 kilolitre	(kL)
One million litres	1 000 000 litres	1 megalitre	(ML)
One thousand million litres	1 000 000 000 litres	1 gigalitre	(GL)

Shortened forms

AHD	Australian height datum
ANCA	Australian national conservation area – wetlands
DoW	Department of Water
DEC	Department of Environment and Conservation
DPI	Department for Planning and Infrastructure
DRF	Declared rare flora or fauna
EPA	Environmental Protection Authority
EPP wetland	Environmental protection policy wetland
EWR	Ecological water requirement
GDE	Groundwater-dependent ecosystem
PASS	Potential acid sulfate soils
PWS	Public water supply
SLIP	State land information platform (formerly Landgate)
SWCC	South West Catchments Council
TEC	Threatened ecological community
WAPC	Western Australian Planning Commission

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