



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

# Environmental management of groundwater from the Jandakot Mound

Triennial compliance report to the Office of the Environmental Protection Authority

February 2015

*Securing Western Australia's water future*



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Environmental Protection Authority

July 2011 to June 2014

*Securing Western Australia's water future*

Department of Water

February 2015

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# 1 Introduction

This report describes the Department of Water's compliance with Ministerial conditions and commitments, set by the Minister for Environment, for the Jandakot Groundwater Mound for the period 1 July 2011 to 30 June 2014. These conditions and commitments, including water level criteria, are stated in *Ministerial Statement No. 688* (Government of Western Australia 2005). The report also outlines the environmental monitoring, management actions, research initiatives and consultation the department undertakes to manage the groundwater resources of the Jandakot system in a sustainable manner.

*Ministerial Statement No. 688* sets environmental water provisions in the form of water level criteria at 23 sites across the Jandakot Mound – 10 wetland sites, nine terrestrial phreatophytic vegetation sites and four rare flora sites across the Jandakot, Perth and Cockburn groundwater areas (Figure 1).

Ministerial conditions and commitments were established in 1992 to manage the development of groundwater abstraction for public water supply and the expected growth in private licensed use. The conditions and commitments have been revised several times to remove sites at which the environmental values identified for protection have been lost due to causes other than abstraction. These causes include the drying climate, land clearing and disturbance related to changing land use. The most recent revision in 2005 removed 15 sites and amended the water level criteria at five sites. Increased rainfall variability and reduced recharge to groundwater associated with the drying climate in the south-west of Western Australia continues to contribute to non-compliance with water level criteria.

The department manages abstraction from the Jandakot groundwater system to meet water level criteria and to minimise environmental impacts. We use water allocation limits and licensing of groundwater abstraction as the main mechanisms to manage groundwater resources. Allocation limits are set for each aquifer by subarea by considering recharge estimates, modelling, environmental objectives and benefits of groundwater use. These limits guide water availability for individual licenses. The department also guides the appropriate use of domestic garden bores which are exempt from licensing under the *Rights in Water and Irrigation Act 1914*.

This report presents licensed water entitlement totals from groundwater subareas related to the Ministerial sites on the Jandakot Mound, focusing on the Superficial aquifer (see tables 1, 2 and 3).

For each year over the triennial reporting period, 1 July 2011 to 30 June 2014, the same five sites were non-compliant with absolute minimum water level criteria.

**Table 1** *Rainfall, water use from the Superficial aquifer and number of sites non-compliant with absolute minimum and/or peak water level criteria for the reporting period*

	<b>Jandakot Mound (Superficial aquifer)</b>		
	<b>2011–12</b>	<b>2012–13</b>	<b>2013–14</b>
Rainfall <sup>1</sup>	882.2 mm	667.6 mm	863.6 mm
Public water supply entitlements	2.80 GL	3.05 <sup>2</sup> GL	2.90 GL
Private licensed entitlements and commitments	35.28 GL	34.94 GL	35.22 GL
Estimated garden bore use <sup>3</sup>	1.00 GL	1.00 GL	1.00 GL
Non-compliance <sup>4</sup>	5/23	5/23	5/23

<sup>1</sup> Rainfall figures are for the months July to June, corresponding with the reporting period. Figures are taken from Jandakot Airport (BoM station no. 9172).

<sup>2</sup> This figure has been updated from the 3.04 GL reported in 2012–13 as it was found to include a rounding error of 0.01 GL.

<sup>3</sup> Garden bore use is estimated using data collected through surveys, data from the Australian Bureau of Statistics and records of household use from the Water Corporation. The figure is for the Jandakot Groundwater Area only.

<sup>4</sup> For full details of compliance see Table 4 and Appendix A.



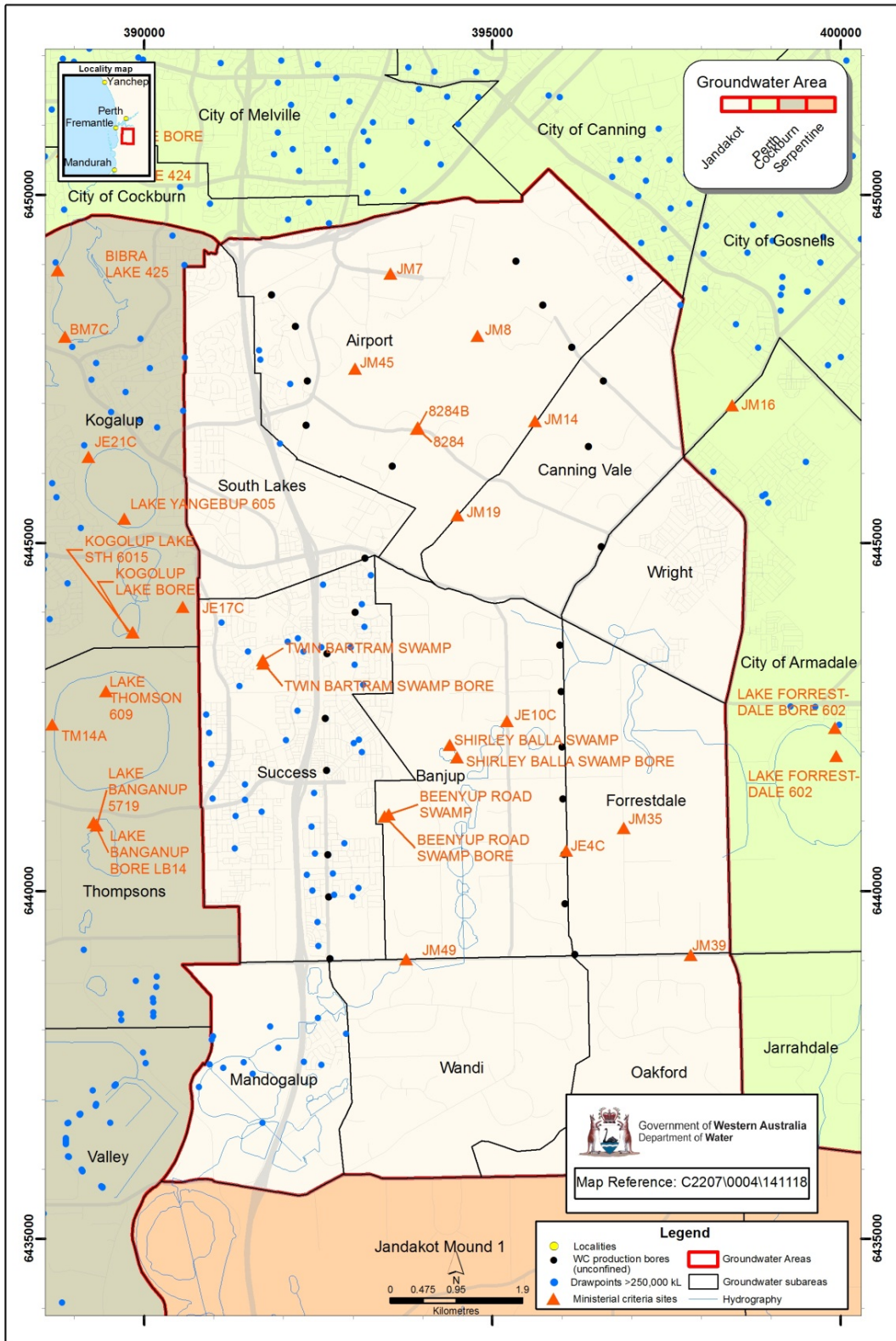


Figure 1 Jandakot groundwater system – location of Ministerial sites, public water supply production bores and private licensed entitlements (drawpoints)

## 2 The Jandakot groundwater system

The Jandakot groundwater system provides water for public open space, horticulture, industry and gardens, and contributes to Perth's public water supply. The system comprises three main aquifers:

- the shallow unconfined Superficial (water table) aquifer known as the Jandakot Mound
- the deep, partially-confined Leederville aquifer
- the deep, mostly-confined Yarragadee aquifer.

Groundwater levels across the Jandakot Mound have generally declined over the last 30 years, but at a slower rate than seen across the Gnangara Mound. This is due to a combination of factors including:

- the Jandakot Mound receives more rainfall than the Gnangara Mound
- abstraction pressure on the Jandakot Mound is less than on the Gnangara Mound
- large parts of the Jandakot Mound are now urbanised, which has increased recharge.

Most of the Jandakot Mound is separated from the deeper Leederville aquifer by a confining layer of Kardinya Shale that extends under all the criteria sites, except Lake Forrestdale. These relatively impermeable shales limit the potential for inter-aquifer impacts of abstraction across most of the Mound. The disconnection created by the shales means abstraction from the Superficial aquifer has a greater impact on wetlands on the Jandakot Mound than abstraction from the deep aquifers.

### 3 Rainfall and recharge

Groundwater levels of the Superficial aquifer depend on recharge from rainfall. Across the south-west of Western Australia there has been a general trend of declining annual rainfall since the mid 1970’s. A CSIRO investigation of climate change (Bates et al. 2010) along with relevant global climate change models, predict continued rainfall reduction in this region.

Comparison of medium-term (post July 1975) and ten-year average rainfall (post July 2003) at the Jandakot Airport Bureau of Meteorology (BoM) station shows further declines since the 1970’s (Figure 2). Rainfall at Jandakot Airport was 882.2, 667.6 and 863.6 mm in 2011–12, 2012–13 and 2013–14 respectively (Figure 2).

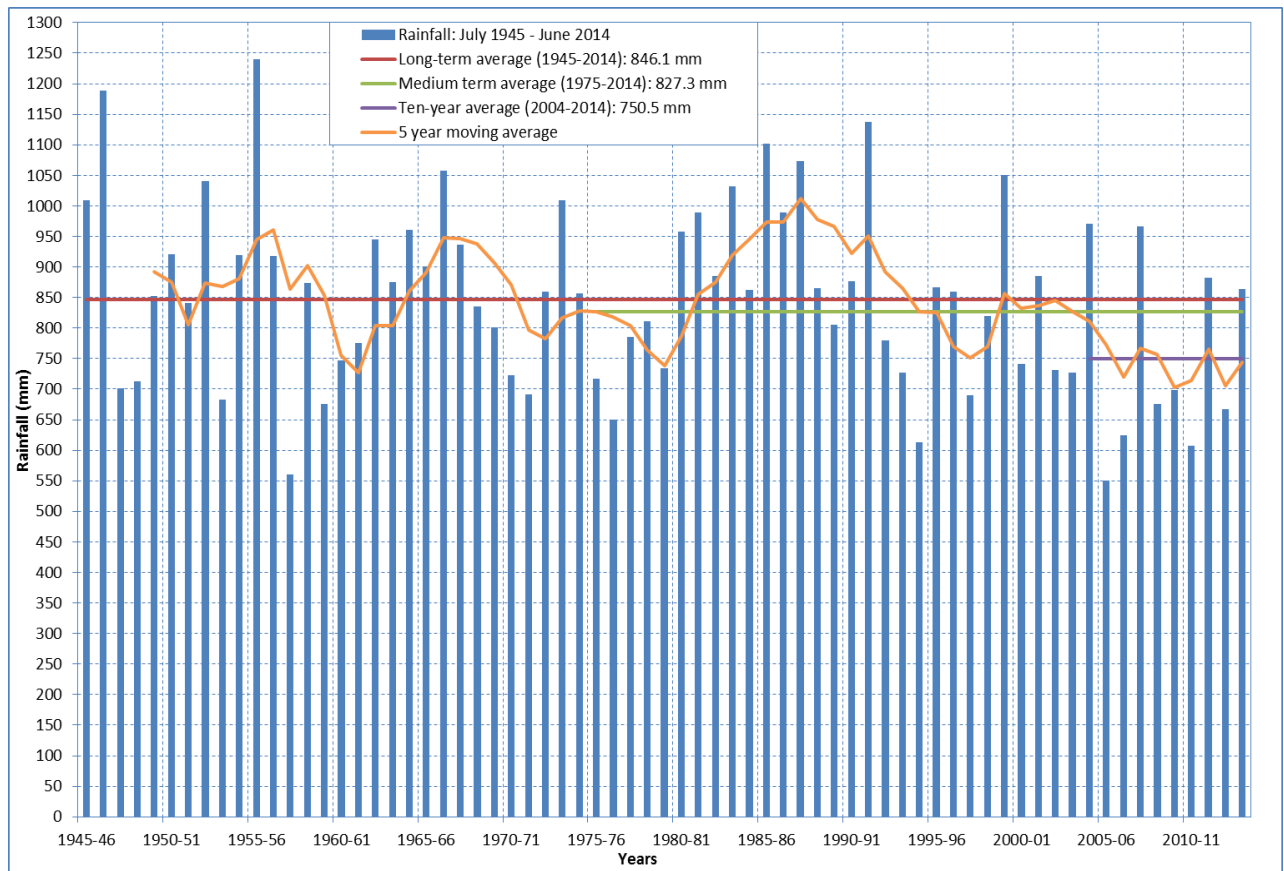


Figure 2 Annual and average water-year rainfall at Jandakot Airport (BoM site 9172)

## 4 Groundwater use

### 4.1 Public water supply

The Department of Water licenses the Water Corporation to take groundwater from the Gnangara and Jandakot groundwater systems for Perth's public water supply. Abstraction from these systems forms an important component of the Integrated Water Supply Scheme (IWSS).

The volumes licensed for public supply from all aquifers of the Jandakot system over the reporting period are shown in Table 2. The presence of the Kardinya Shale means that the volumes licensed from the Leederville and Yarragadee aquifers are very unlikely to impact on wetlands on the Jandakot Mound. Table 3 shows licensed entitlements for public supply from groundwater subareas of the Superficial aquifer.

*Table 2 Public water supply entitlements from all aquifers of the Jandakot groundwater system*

Aquifer	Public water supply entitlements (GL)		
	2011–12	2012–13	2013–14
Superficial	2.80	3.05	2.90
Leederville	8.25	7.45	6.45
Yarragadee	0.66	0.93	4.00 <sup>1</sup>
<b>TOTAL</b>	<b>11.71</b>	<b>11.43</b>	<b>13.35</b>

<sup>1</sup> This volume is comprised of 3 GL for a new Yarragadee bore in the Jandakot Groundwater Area and 1 GL from bore MR17 in the Perth South Groundwater Area.

### 4.2 Private licensed use

Most of the groundwater licensed from the Superficial aquifer is to private users for horticulture, public open space, industry, gardens and recreation grounds.

Over the reporting period, private licensed entitlements from the Superficial aquifer remained relatively stable (Tables 1 and 3). Table 3 shows private entitlements licensed from subareas that contain sites with water level criteria, or from subareas that may impact on these sites.

### 4.3 Garden bore use

Groundwater is also abstracted from the Superficial aquifer through domestic garden bores that are exempt from licensing. The department estimates garden bore use from data collected through surveys and the Australian Bureau of Statistics, and from household use data from the Water Corporation (Table 1).

Table 3 Licensed entitlements for public water supply and private use from the Superficial aquifer within the Jandakot subareas or that impact on Ministerial sites

Groundwater Area	Subarea	Ministerial criteria site present	Allocation limit (GL/yr)	Public water supply entitlements <sup>3</sup> (GL)				Private licensed entitlements <sup>5</sup> (GL)			
				2011–12	2012–13	2013–14	Future water reserve <sup>4</sup>	Quota set by EPA <sup>6</sup>	2011–12	2012–13	2013–14
Jandakot <sup>1</sup>	Airport <sup>5</sup>	Yes	4.29	0.64	0.70	0.69	Yes	1.40	0.63	0.25	0.81
	Banjup <sup>5</sup>	Yes	3.61	0.42	0.43	0.43	Yes	1.80	0.71	0.36	0.37
	Canning Vale <sup>5</sup>	No	1.35	0.45	0.32	0.32	Yes	0.60	0.11	0.06	0.07
	Forrestdale <sup>5</sup>	Yes	2.01	0.08	0.30	0.16	Yes	1.67	0.98	0.70	0.76
	Mandogalup	No	3.00					3.00	1.88	1.17	1.29
	Oakford	Yes	1.37					1.37	0.24	0.83	0.08
	South Lakes	No	1.25					1.25	0.46	0.29	0.36
	Success <sup>5</sup>	Yes	4.30	1.22	1.30	1.30	Yes	2.25	1.05	0.84	0.98
	Wandi	No	1.20					1.20	0.47	0.27	0.29
Wright	No	0.96					0.96	0.79	0.87	0.92	
<b>Total for Jandakot Groundwater Area</b>			<b>23.34</b>	<b>2.80</b>	<b>3.05</b>	<b>2.90</b>		<b>15.50</b>	<b>7.30</b>	<b>5.65</b>	<b>5.93</b>
Perth <sup>2</sup>	City of Armadale	Yes	4.00						3.05	2.92	3.01
	City of Canning	No	3.50						2.25	2.48	2.59
	City of Cockburn	Yes	1.00						0.48	0.48	0.55
	City of Gosnells	No	5.50						3.22	3.24	3.25
	City of Melville	No	5.50						4.18	4.17	4.14
<b>Total for Perth South Groundwater Area</b>			<b>19.50</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>			<b>13.19</b>	<b>13.30</b>	<b>13.54</b>
Cockburn	Kogalup	Yes	11.46						9.86	10.36	10.13
	Thompsons	Yes	8.70						5.60	5.63	5.63
<b>Total for Cockburn Groundwater Area</b>			<b>20.16</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>			<b>15.46</b>	<b>15.99</b>	<b>15.76</b>
<b>Total for Jandakot subareas that affect Ministerial criteria sites</b>			<b>63.00</b>	<b>2.80</b>	<b>3.05</b>	<b>2.90</b>			<b>35.95</b>	<b>34.94</b>	<b>35.22</b>

<sup>1</sup> A review of allocation limits for the Jandakot Groundwater Area has recently been finalised (see Section 6.2.1). The limits shown in this table are the old limits as the review was completed after 30 June 2014.

<sup>2</sup> Allocation limits for the Gnangara groundwater areas were reviewed in 2007 and finalised in the *Gnangara groundwater areas allocation plan* (DoW 2009a). This allocation limit review also included subareas within the Perth South Groundwater Area located to the south of the Swan River.

<sup>3</sup> Public water supply information is from both the Water Resourcing Licensing System and annual reports submitted to the Department of Water by the Water Corporation as a condition of their licence.

<sup>4</sup> For subareas containing groundwater reserved for future public water supply, the reserve volumes are NOT included in the licensed entitlement figures presented. The reserved volumes will be amended as part of the review of allocation limits in the Jandakot Groundwater Area.

<sup>5</sup> The source of private licensed entitlement and commitments data is the department's Water Resourcing Licensing System (2011–12 report run on 1 July 2012, 2012–13 report run on 1 July 2013, 2013–14 report run on 30 June 2014).

<sup>6</sup> The quota for private licensed allocation was set in accordance with the Environmental Management Program by the EPA in 1992. Since then the South Lakes subarea has been expanded to include the Yangebup subarea.

Also note:

From 2013-14 onwards the department has a new method for storing and extracting water licensing data.

Up-to-date figures on water availability are available from the Swan Avon Regional office.

1 GL = 1 000 000 kL.

Figures have been rounded to two decimal places.

## 5 Compliance

The conditions and commitments from *Ministerial Statement No. 688* that the Department of Water is required to comply with are shown in Appendix A and B (the ‘audit tables’). The Office of the Environmental Protection Authority (OEPA) and the Department of Environment and Conservation (now the Department of Parks and Wildlife) cleared some of the conditions and commitments in the statements and we therefore no longer report against them.

### 5.1 Compliance with water level criteria

*Ministerial Statement No. 688* sets water level criteria at 23 sites across the Jandakot Mound (Figure 1). There are 10 wetland sites, nine terrestrial phreatophytic vegetation monitoring sites and four rare flora sites. Phreatophytic vegetation is vegetation that uses groundwater to meet at least part of its water needs.

Some sites have more than one water level criterion and can be non-compliant with multiple criteria. Water level criteria include:

- absolute minimum levels – these are used as the main indication of compliance from year to year
- levels allowed to fall between a preferred minimum and the absolute minimum in two of six years to replicate natural drying cycles – these are referred to as ‘other’ water level criteria in this report and provide information on water level trends
- rate of decline and timing of drying – these are also referred to as ‘other’ water level criteria in this report.

For each year over the triennial reporting period, the same five sites were non-compliant with absolute minimum criteria (Table 4). Water levels at most sites have improved since 2010–11.

Our management and mitigation actions in response to non-compliance are in Section 6. Details for individual sites can be found in Appendix A.

Table 4 Summary of sites non-compliant with water level criteria

Year	Compliance					
	Absolute minimum water level criteria			Other water level criterion		
	Wetlands	Terrestrial and rare flora vegetation	Total non-compliant	Wetlands	Terrestrial and rare flora vegetation	Total non-compliant
2011–12	North Lake Bibra Lake Lake Forrestdale Lake Banganup Shirley Balla Swamp	None	5/23	Bibra Lake Thomsons Lake Lake Forrestdale Shirley Balla Swamp	None	4/12
2012–13	North Lake Bibra Lake Lake Forrestdale Lake Banganup Shirley Balla Swamp	None	5/23	Bibra Lake Thomsons Lake Lake Forrestdale Shirley Balla Swamp	None	4/12
2013–14	North Lake Bibra Lake Lake Forrestdale Lake Banganup Shirley Balla Swamp	None	5/23	Bibra Lake Thomsons Lake Lake Forrestdale Shirley Balla Swamp	None	4/12

## 6 Environmental monitoring, management actions, research initiatives and consultation

### 6.1 Environmental monitoring

Expert environmental consultants undertake environmental monitoring for the department in line with the commitments in *Ministerial Statement No. 688*. The monitoring program was reviewed in 2009 and 2013 (see Appendix D) to improve the cost effectiveness and efficiency. The program includes monitoring of:

- wetland vegetation
- terrestrial vegetation
- wetland macroinvertebrates and water quality.

Ecological condition is affected by a number of factors that influence water levels, including abstraction. Condition is also affected by other factors such as fire and disturbance related to changing land use. We use the results of environmental monitoring to continually improve our understanding of the relationship between water levels and ecological condition. We also use the information to manage abstraction at priority locations, where reduced abstraction is likely to improve ecological condition.

#### 6.1.1 Wetland vegetation

Over the reporting period, wetland vegetation condition was monitored in spring at Banganup Lake, North Lake, Thomsons Lake, Bibra Lake, Beenyup Road Swamp, Twin Bartram Swamp, Lake Forrestdale, Kogolup Lake, Shirley Balla Swamp and The Spectacles (Wilson and Froend 2012; Wilson et al. 2013; Wilson and Froend 2014).

In recent years tree canopy condition has improved at a number of sites including Banganup Lake, North Lake, Beenyup Road Swamp, Thomsons Lake and Forrestdale Lake. However, declines in canopy condition were recorded at Twin Bartram Swamp, Bibra Lake, The Spectacles and Kogolup Lake when the sites were last monitored. Canopy condition decline and tree deaths were also recorded at Shirley Balla Swamp when it was last monitored in 2012–13 and the site was highlighted as a wetland of concern.

#### 6.1.2 Terrestrial vegetation

Terrestrial vegetation was monitored at five sites in 2013–14 (Syrinx Environmental 2014). The results showed a continued decline of most overstorey and understorey species at most sites, continuing a general declining trend evident since 1997. However, the rate of decline between 2010 and 2013 was substantially lower than that recorded between 2000 and 2010, with results indicating stabilisation or recovery in abundance and/or health of several species (Syrinx Environmental 2014).



### 6.1.3 Wetland macroinvertebrates and water quality

Over the reporting period, macroinvertebrates and water quality were monitored in spring at sites including Thomsons Lake, Kogolup Lake, Lake Yangebup, The Spectacles, Lake Forrestdale and Shirley Balla Swamp (Strehlow et al. 2012; Strehlow et al. 2013; Sampey et al. 2014).

Water quality was similar to previous years, except for the low pH recorded at Thomsons Lake in 2012–13, which returned to within the historic range in 2013–14. Nutrient concentrations were mostly within normal ranges, though concentrations generally exceeded ANZECC/ARMCANZ trigger values.

When last monitored in 2012–13, macroinvertebrate species richness was below average at The Spectacles and above average at Lake Yangebup and Kogolup Lake. Shirley Balla Swamp was scheduled to be monitored in 2012–13 but could not be sampled because it was dry.

Macroinvertebrate species richness was higher than in previous years at all three wetlands (Lake Forrestdale, Kogolup Lake South and Thomsons Lake) monitored in 2013–14.

## 6.2 Management actions

The department's primary approach to non-compliance on the Jandakot Mound is to manage abstraction more stringently in areas where it can lead to improved groundwater levels and ecological condition at non-compliant sites.

### 6.2.1 Jandakot Groundwater Area allocation limit review

The department has recently finalised a review of allocation limits for the Jandakot Groundwater Area. The updated allocation limits consider the drying climate and align with the environmental objectives for the Jandakot Mound in *Ministerial Statement No. 688*. The new limits reduce the risk of increased non-compliance associated with increases in abstraction. The review has reduced future water availability in the area by approximately 8 GL per year, without impacting on current use.

### 6.2.2 Managing public water supply allocations

As outlined in the 2009 *Gnangara groundwater areas allocation plan*, the addition of the Southern Seawater Desalination Plant to the Integrated Water Supply Scheme (IWSS) triggered a change in how groundwater for the public water supply is allocated. In line with the plan, from 2012–13 the Water Corporation's IWSS allocation from existing infrastructure on the Gnangara and Jandakot systems has been reduced from 145 GL to 120 GL per year.

Under the 120 GL per year allocation, the licensed volume from the Superficial aquifer of the Jandakot system has been reduced in areas where the reductions would most benefit water levels and ecological condition at non-compliant sites.

In 2013–14, 3 GL was licensed from a new Yarragadee bore in the Jandakot Groundwater Area. Allocations from the new bore are treated separately to the

GL per year allocation as the licence was assessed independently and will not impact on Superficial aquifer levels in the area.

We review the distribution of the Water Corporation's groundwater licences every water year and when necessary implement changes, based on compliance and water level trends, that aim to further reduce abstraction impacts at non-compliant sites.

### 6.2.3 Managing private licensed use

Most of the groundwater now licensed from the Superficial aquifer is to private users. Private licensed use is managed through on-ground compliance inspections, meter audits and water use surveys. We use this work to check that groundwater use is within licence entitlements and that site activities are authorised.

The department has prioritised its compliance and enforcement activities to consider conditions and commitments set in *Ministerial Statement No. 688*. This included expanding the scope of our compliance monitoring plan to focus on areas where non-compliances are potentially affecting sites with water level criteria. The department also manages the use of groundwater by private licensees in other ways including:

- We work with local governments, urban developers and other licensees using large volumes to improve water use efficiency, reduce demand for groundwater, assess water needs for future public open space and assess supply options.
- We updated our water trading policy and listed a web-based register of licensees in 2010 to facilitate water trades as a way to optimise water use.

### 6.2.4 Managing garden bore use

The efficient use of water from domestic garden bores can reduce demand on scheme water. The department developed a garden bore use guideline in 2011, emphasising water conservation and efficiency. We now have an updated garden bore suitability map available in the Perth Groundwater Atlas online (accessed through the department's website). In suitable areas, we support the establishment and efficient use of domestic garden bores in preference to using scheme water. However, garden bores are not encouraged in areas where there is a risk of acid sulfate soils, poor water quality or low yields. These areas are identified in the suitability map in the atlas.

To preserve water resources and encourage greater water use efficiency by the community, water restrictions on the use of garden bores were initiated in 2007 under the Rights in Water and Irrigation Exemption (Section 26C) Order 2007. In 2010, the total winter sprinkler ban came into effect and is enforced by the Water Agencies (Water Use) By-laws 2010. The by-laws restricts use of domestic garden bores to a roster of three days a week with a total use-ban during winter.

The annual winter sprinkler ban is now in its fifth year. It has become an accepted part of the water use calendar, as shown by a strong reduction in infringements for using garden bores during the ban.

## 6.3 Research initiatives

The department, in collaboration with research partners, is completing a number of major projects to focus management effort on the areas that will show the most benefit from changes to abstraction.

The Perth Regional Aquifer Modelling System (PRAMS) has recently been updated. We are using PRAMS for detailed modelling of interactions between climate, land use and groundwater abstraction. This will support future licensing and allocation limit decisions on the Jandakot system.

The department has developed a future climate tool that will help us better predict rainfall in our drying climate. The peer reviewed tool was built using global climate models that perform well in Western Australia. It will ensure that we use robust, up-to-date and defensible climate science in our decision making. A report outlining how we developed the climate tool - Selection of future climate projections for Western Australia - is being finalised for publication.

Through the department's Perth Regional Confined Aquifer Capacity (PRCAC) project we are investigating the sustainability of current abstraction from the Leederville and Yarragadee aquifers. The project will help identify whether additional abstraction from these aquifers could be a viable source option for public water supply. Of particular interest is how managed aquifer recharge could be used to maximise abstraction from these aquifers while protecting groundwater-dependent ecosystems and managing sea water intrusion.

The department's Perth shallow groundwater system investigation included studies at North Lake, Lake Forrestdale and Thomsons Lake. Through these studies we have improved our understanding of relationships between wetlands and the Superficial aquifer, and the impacts of climate change, land use and abstraction. The department is using the studies to better relate water levels to ecological condition and to manage local abstraction.

The department commissioned Edith Cowan University to develop an ecological risk model based on 30 years of ecological and hydrological monitoring data. It will be an important management tool for assessing risk to groundwater-dependent vegetation and the impact of future land uses under different climate and abstraction regimes.

## 6.4 Consultation

The department engages regularly with the community through public seminars, conferences, workshops and community meetings - including annual presentations to the Jandakot Community Consultative Committee (JCCC). In 2012–13 we presented at the Western Australian Wetlands Management Conference and to the Wetlands Coordinating Committee. We also held an additional meeting with the JCCC in 2014 to discuss the Jandakot Groundwater Area allocation limit review.

To minimise the impacts on groundwater-dependent ecosystems, the department provides advice to local and state government agencies on water supply, including water for public open space, and on development proposals as required. For example, during the reporting period the department provided a detailed submission

on the *Roe Highway Extension - Public Environmental Review* and ongoing advice on the proposal to the OEPA.

Through the *Better urban water management framework* (Western Australian Planning Commission 2008) we also provide local government authorities and other land development agencies with advice on water management in urban areas to minimise the effects of drainage and stormwater on shallow groundwater in the Jandakot area.

# Appendices





Wetland	AWRC reference number	Water level criteria (mAHD)		Other criteria	Water level (mAHD)													Comments on compliance during the triennial reporting period (1 July 2011– 30 June 2014)		
		Preferred	Absolute			2000–01	2001–02	2002–03	2003–04	2004–05	2005–06	2006–07	2007–08	2008–09	2009–10	2010–11	2011–12		2012–13	2013–14
	Bore LB14 61419614				Max						12.7	12.4	12.6	12.6	12.5	12.0	12.3	12.1	12.4	<p>peak groundwater levels in 2013–14 were the highest recorded since 2009–10.</p> <p><u>Management and mitigation:</u></p> <p>The department has recently finalised a review of allocation limits in the Jandakot Groundwater Area, considering compliance, water level trends and ecological health at the lake.</p> <p>The revised allocation limits will reduce the risk of future increases in abstraction impacting on lake levels.</p>
					Min	11.6	11.6	11.5	11.5	11.5	11.8	11.5	11.7	11.5	11.6	11.2	11.4	11.4	11.4	
Twin Bartram Swamp	Staff JE7C 6142544	22.8	22.5	Not to dry before end of January. Must be above preferred minimum 4 in every 6 years.	Max			24.1	24.4	24.5	24.4	23.8	23.8	24.4	24.4	23.7	23.8	24.3	24.7	<p><u>Compliance and trends:</u></p> <p><b>Compliant with absolute summer minimum and other criterion.</b></p> <p>The peak surface water level in 2013–14 was the highest on record and the minimum level was the highest recorded since 2009–10.</p>
	Min				23.0 dry 07/03	23.0 dry 03/02	23.0 dry 26/02	23.0 dry 25/03	23.0 dry 22/03	23.6	dry 12/01	dry 09/01	23.5	23.2	23.0 dry 04/01	23.1	23.2	23.4		
	Max									24.5	23.9	24.4	24.5	24.5	23.8	23.9	24.3	24.7		
	Min				23.0	23.1	23.0	23.2	23.2	23.6	23.0	23.1	23.5	23.4	22.7	23.1	23.3	23.4		
Shirley Balla Swamp	Staff 6142576	23.1 or 0.5 m below lake base, whichever is the higher	24.5	Not to dry before end of January. Must be above preferred minimum 4 in every 6 years. Water levels should not decline at rate greater than 0.1 m/year. Monitor staff gauge.	Max			25.2		25.2	25.6	25.1	25.0	25.0	25.0	25.1	25.1	25.0	25.2	<p><u>Compliance and trends:</u></p> <p><b>Non-compliant with absolute summer minimum criterion.</b></p> <p>Groundwater levels are consistently non-compliant with the absolute minimum criteria though the minimum groundwater level in 2013–14 was the highest recorded since 2005–06.</p> <p><b>Non-compliant with other criterion.</b></p> <p>The swamp dries every year.</p> <p><u>Management and mitigation:</u></p> <p>The department has recently finalised a review of allocation limits in the Jandakot Groundwater Area, considering compliance, water level trends and ecological health at the lake.</p> <p>The revised allocation limits will reduce the risk of future increases in abstraction impacting on lake levels.</p> <p><u>Additional information:</u></p> <p>The EPA endorsed new absolute minimum water level criterion in 2004. However, no preferred minimum was established. Therefore the 4 in 6 year criteria cannot be applied. Further review of criteria is required.</p>
	Min				dry 02/01	dry 03/12	dry 03/12	dry 27/11	dry 27/11	dry 21/02	dry 27/09	dry	dry	dry	dry	dry 01/09	dry 01/12	dry 05/11	dry 02/12	
	Max							25.4	25.2	25.7	24.9	25.0	25.4	25.3	24.6	24.6	25.1	25.3		
	Min				24.3	24.3	24.2	24.2	24.1	24.5	24.0	24.3	24.2	24.2	23.8	24.3	24.1	24.4		
Beenyup Road Swamp	Staff 6142547	24.0	23.6	Bore must be above preferred minimum 4 in every 6 years.	Max			24.7	24.9	24.8	25.2	24.6	24.7	25.1	25.1	24.7	25.1	25.1	25.3	<p><u>Compliance:</u></p> <p><b>Compliant with absolute summer minimum and other criterion.</b></p> <p>Surface water levels in 2013–14 were the highest on record.</p>
	Min									24.6	24.6 dry	24.6 dry	24.6 dry	24.6 dry	24.6 dry	24.6 dry	24.6 dry	24.6 dry		
	Max				25.0	24.7	24.3	24.8	24.6	25.2	24.5	24.9	25.1	25.2	24.7	25.2	25.1	25.4		
	Min				23.7	23.7	23.5	23.7	23.8	24.2	23.8	24.1	24.2	24.2	23.9	24.3	24.3	24.4		



Table 2 Rare flora and phreatophytic flora sites

Monitoring bore	AWRC Ref.	Water level criteria (mAHD)		Other criterion	Water level (mAHD)														Comments on compliance during the triennial reporting period (1 July 2011– 30 June 2014)	
		Preferred	Absolute			2000–01	2001–02	2002–03	2003–04	2004–05	2005–06	2006–07	2007–08	2008–09	2009–10	2010–11	2011–12	2012–13		2013–14
<b>Vegetation wells</b>																				
JM14	61610247	24.39	23.89		Max			25.67	25.72	25.74	26.27	25.33	25.08	25.65	25.64	25.08	25.30	25.16	25.67	Compliance: Compliant with absolute summer minimum criterion.
					Min	24.71	24.53	24.47	24.59	24.34	24.91	24.05	24.39	24.63	24.64	23.82	24.59	24.34	24.61	
JM16	61610445	23.90	23.40		Max			25.47	25.73	25.37	25.95	25.02	25.19	25.51	25.50	24.95	25.27	24.94	25.53	Compliance: Compliant with absolute summer minimum criterion.
					Min	24.59	24.31	24.29	24.30	24.28	24.59	24.09	24.30	24.26	24.38	23.98	24.31	24.17	24.31	
JM19	61610177	25.26	24.76		Max			26.16	26.02	25.95	26.57	25.77	25.68	26.51	26.27	25.59	25.90	25.65	26.06	Compliance: Compliant with absolute summer minimum criterion.
					Min	25.08	25.16	24.76	24.90	24.90	25.33	24.41	24.90	25.16	25.26	24.29	25.12	24.86	24.90	
JM35	61610333	21.25	20.75		Max			25.58	26.03	25.83	26.24	25.43	25.64	25.95	25.82	24.33	25.68	25.44	25.76	Compliance: Compliant with absolute summer minimum criterion.
					Min	23.44	23.47	23.32	23.41	24.44	24.86	24.23	24.63	23.60	23.11	21.22	21.74	23.42	24.08	
JM39	61410142	21.20	20.70		Max			24.10	24.49	24.20	24.48	23.06	23.12	23.87	24.27	22.66	23.86	23.46	23.80	Compliance: Compliant with absolute summer minimum criterion.
					Min	21.56	21.65	21.49	21.67	21.66	22.06	21.30	21.56	21.56	21.62	21.16	21.86	21.88	21.52	
JM49	61410111	22.34	21.84		Max	23.65	23.78	23.69	23.81	23.88	24.04	23.71	23.76	23.80	23.81	23.49	23.86	23.73	23.89	Compliance: Compliant with absolute summer minimum criterion.
					Min	23.09	23.10	23.04	23.15	23.12	23.29	22.92	23.15	23.12	23.19	22.75	23.25	22.98	23.04	
8284	61610178	24.82	24.32		Max			25.90	25.80	25.90	26.30	25.60	25.80	25.80	25.70	25.35	25.62	25.38	25.79	Compliance: Compliant with absolute summer minimum criterion.  Additional information: Unable to monitor compliance with absolute summer minimum when levels fall below 25 mAHD as the current bore is not deep enough. The department recommends using the recently installed 8284B (AWRC ref. 61611864) to measure water level criteria.
					Min	25.40	25.30	25.00	25.10	25.10	25.30	25.00	25.00	25.00	25.00	25.00	25.03	25.00	25.07	
JE4C	61610234	24.00	23.50		Max			24.93	25.54	25.32	26.06	25.19	25.18	25.85	25.70	24.83	25.63	23.85	25.81	Compliance: Compliant with absolute summer minimum criterion.
					Min	24.10	24.05	23.95	24.14	24.21	24.76	24.00	24.41	24.49	24.43	24.00	24.78	23.30	24.59	
JE10C	61410250	21.80	21.30		Max		26.09	26.14	23.25	26.10	26.32	25.21	25.39	25.79	25.98	24.86	25.28	25.06	25.72	Compliance: Compliant with absolute summer minimum criterion.
					Min	23.08	23.86	23.67	23.83	23.68	23.86	22.66	23.70	23.46	23.25	22.46	23.81	23.26	23.31	

Monitoring bore	AWRC Ref.	Water level criteria (mAHD)		Other criterion	Water level (mAHD)														Comments	
		Preferred	Absolute			2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13		2013-14
<b>Rare Flora Wells</b>																				
JM7	61610180		22.06	< 0.1 m decline per year	Max			23.65	23.73	23.42	24.01	23.29	23.38	23.86	23.84	23.27	23.84	23.85	24.48	Compliance: Compliant with absolute summer minimum criterion.
					Min	23.06	22.97	22.80	22.79	22.71	23.06	22.52	22.82	22.90	22.97	22.30	23.13	23.06	23.59	
JM8	61610248		23.38	< 0.1 m decline per year	Max			25.08	25.21	24.98	25.51	24.63	24.57	25.00	25.12	24.49	24.88	24.66	25.29	Compliance: Compliant with absolute summer minimum criterion.
					Min	24.34	24.24	24.10	24.11	24.05	24.34	23.77	24.02	24.09	24.19	23.67	24.15	23.96	24.42	
JM45	61610179		22.71	< 0.1 m decline per year	Max			24.34	24.22	24.12	24.70	23.88	23.57	24.12	24.12	23.62	23.91	23.85	24.45	Compliance: Compliant with absolute summer minimum criterion.
					Min	23.68	23.69	23.42	23.43	23.34	23.67	23.03	23.17	23.38	23.38	22.71	23.45	23.30	23.72	
JE17C	61419703		16.35	< 0.1 m decline per year	Max			18.08	18.12	18.10	18.19	18.01	18.12	18.15	18.13	18.06	18.05	18.06	18.16	Compliance: Compliant with absolute summer minimum criterion.
					Min	17.31	17.44	17.38	17.50	17.63	17.67	17.37	17.46	17.53	17.68	16.97	17.48	17.36	17.55	

Note: Water levels are permitted to fall between the preferred and absolute criteria levels. Non-compliances exist when groundwater levels fall below the absolute minimum criteria.

## Appendix B.— Audit table: Environmental conditions, procedures and commitments, Jandakot Mound groundwater resources

Proponent: Department of Water

Period: 1 July 2011 to 30 June 2014

Text in blue represents where the Department of Water seeks advice from the Department of Parks and Wildlife (DPaW)/Office of the Environmental Protection Authority (OEPA) on 'clearing' conditions/proponent commitments.

Note: *Ministerial Statement 688* refers to the Water and Rivers Commission (now Department of Water) responsibilities to the OEPA. In some cases, although referred below as OEPA, some responsibilities now lie with the DPaW).

Table 1 Ministerial conditions and procedures

Audit code	Subject	Action	How	Evidence	Requirement of	On advice from	Phase	When/Where	Status
688: M 1-1	Implementation	The proponent shall implement the proposals as documented in "Section 46 Review of Environmental Conditions on Management of the Gnarara and Jandakot Mounds – Stage 1 Proposal for Changes to Conditions" (August 2004), as modified and documented in Environmental Protection Authority Bulletin 1155.	Implement proposals (conditions, procedures) given in EPA Bulletin 1155 and <i>Ministerial Statement No. 688</i> .	Compliance report.	Minister for the Environment		Overall		<b>Partly compliant.</b> Compliant with majority of Ministerial conditions – refer to the 'status' column of this Appendix.
688: M 2-1	Proponent commitments	The proponent shall implement the environmental management commitments, as revised in December 2004, and documented in schedule 1 of Statement 688, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority (EPA).	Implement environmental management commitments given in EPA Bulletin 1155 and <i>Ministerial Statement No. 688</i> .	Compliance report	Minister for the Environment	EPA	Overall		<b>Partly compliant.</b> Compliant with majority of proponent commitments – refer to the 'status' column of this Appendix.
688: M 3-1	Proponent nomination & contact details	The proponent for the time being nominated by the Minister for the Environment under section 38(6) or (7) of the <i>Environmental Protection Act 1986</i> is responsible for the implementation of the proposal until such time as the Minister for the Environment has exercised the Minister's power under section 38(7) of the Act to revoke the nomination of that proponent and nominate another person as the proponent for the proposal.	Adhere to conditions, procedures and commitments given in EPA Bulletin 1155 and <i>Ministerial Statement No. 688</i> .	Letter notifying the Chief Executive Officer of the OEPA of any change in proponent details.	Minister for the Environment	EPA	Overall		<b>N/A at this time.</b>
688: M 3-2	Proponent nomination & contact details	If the proponent wishes to relinquish the nomination, the proponent shall apply for the transfer of proponent and provide a letter with a copy of this statement endorsed by the proposed replacement proponent that the proposal will be carried out in accordance with this statement. Contact details and appropriate documentation on the capability of the proposed replacement proponent to carry out the proposal shall also be provided.	Follow procedure given in 'action'.	Letter notifying the Chief Executive Officer of the OEPA of any change in proponent details.	Minister for the Environment		Overall		<b>N/A at this time.</b>
688: M 3-3	Proponent nomination & contact details	The nominated proponent shall notify the OEPA of any change of contact name and address within 60 days of such change.	Follow procedure given in 'action'.	Letter notifying the Chief Executive Officer of the OEPA of any change in proponent details.	CEO		Overall	60 days of change	<b>N/A at this time.</b>
688: M 4-1	Commencement and time limit of approval	The proponent shall provide evidence to the Minister for the Environment within five years of the date of this statement that the proposals have been substantially commenced or the approvals granted in the statements of 8 March 1988 and 17 February 1999 shall lapse and be void.	Provide evidence in annual/triennial reports.	Compliance report.			Overall	Condition complete	<b>The Department of Water seeks advice on 'clearing' this condition.</b> The 'status of implementation of the proposals' is 'completed' as Jandakot scheme stage 1 and 2 are fully commissioned.
688: M 5-1 1	Compliance audit and performance review	The proponent shall prepare an audit program and submit compliance reports to the OEPA which address: 1. the status of implementation of the proposals	Detail in annual/triennial reports. Compliance report will include: 1. the status of implementation of the proposals	Compliance report.	CEO		Overall	Condition complete	<b>The Department of Water seeks advice on 'clearing' this condition.</b> Audit program prepared (see 688: P 14) and submitted to EPA 25 November 2005. The 'status of implementation of the proposals' is 'completed' as Jandakot scheme stage 1 and 2 are fully commissioned.
688: M 5-1 2	Compliance audit and performance review	The proponent shall prepare an audit program and submit compliance reports to the OEPA which address: 2. evidence of compliance with the conditions and commitments	Detail in annual/triennial reports. Compliance report will include: 2. evidence of compliance with the conditions and commitments	Compliance report.	CEO			Annually	<b>Compliant.</b> Detailed in the annual report and the 'status' column of this Appendix.

Audit code	Subject	Action	How	Evidence	Requirement of	On advice from	Phase	When/Where	Status
688: M 5-1 3	Compliance audit and performance review	The proponent shall prepare an audit program and submit compliance reports to the OEPA which address: 3. the performance of the environmental management plans and programs. Note: Under delegation No. 54 issued on 18 June 2004 and section 48(1) of the <i>Environmental Protection Act 1986</i> , the EPA is empowered to monitor the compliance of the proponent with the statement and should directly receive the compliance documentation, including environmental management plans, related to the conditions, procedures and commitments contained in this statement.	Detail in annual/triennial reports. Compliance report will include: 3. the performance of the environmental management plans and programs.	Compliance report.	CEO			Annually	<b>Compliant.</b> Detailed in the annual report and the 'status' column of this Appendix. Also refer to the results given in Appendix A and Table 4.
688: M 5-2 1	Compliance audit and performance review	The proponent shall submit a performance review report by 1 December each year and more detailed reports by 1 February every three years, to the requirements of the EPA, which address: 1. compliance with the conditions	The performance review will address: 1. compliance with the conditions	Compliance report.	CEO		Overall	By 1 December each year and more detailed reports by 1 February every three years.	<b>Compliant.</b> Detailed in the annual report and the 'status' column of this Appendix. Also refer to the results given in Appendix A and Table 4.
688: M 5-2 2	Compliance audit and performance review	The proponent shall submit a performance review report by 1 December each year and more detailed reports by 1 February every three years, to the requirements of the EPA, which address: 2. the achievement of environmental objectives set for the proposal	The performance review will address: 2. the achievement of environmental objectives set for the proposal	Compliance report.	CEO		Overall	By 1 December each year and more detailed reports by 1 February every three years.	<b>Compliant.</b> Detailed in the annual report. Evidence of achievement of the 'objectives' are given in the 'evidence' & 'status' columns of this Appendix.
688: M 5-2 3	Compliance audit and performance review	The proponent shall submit a performance review report by 1 December each year and more detailed reports by 1 February every three years, to the requirements of the EPA, which address: 3. stakeholder and community consultation about environmental performance and the outcomes of that consultation, including a report of any on-going concerns being expressed	The performance review will address: 3. stakeholder and community consultation about environmental performance and the outcomes of that consultation, including a report of any on-going concerns being expressed. Comply with commitments 688: P 7, 9, 10, 11, 16, 17.	Compliance report.	CEO		Overall	By 1 December each year and more detailed reports by 1 February every three years.	<b>Compliant.</b> Detailed in annual report. The Jandakot Community Consultative Committee (JCCC) met in August every year of the reporting period and discussed the environmental management of abstraction from the Jandakot groundwater system.
688: M 5-2 4	Compliance audit and performance review	The proponent shall submit a performance review report by 1 December each year and more detailed reports by 1 February every three years, to the requirements of the EPA, which address: 4. proposed environmental management over the next three years to comply with conditions and environmental objectives set for the proposal.	The performance review will address: 4. proposed environmental management over the next three years to comply with conditions and environmental objectives set for the proposal.	Compliance report.	CEO		Overall	By 1 December each year and more detailed reports by 1 February every three years.	<b>Compliant.</b> The department is continuing to review and refine its environmental management of Jandakot groundwater resources using results from: • environmental monitoring (see Section 6.1) • hydrogeological investigations including the Perth shallow groundwater systems investigation (see Section 6.3). Outcomes from environmental monitoring and hydrogeological investigations were incorporated into the review of allocation limits for the Jandakot Groundwater Area and are used in licence assessments.
688: M 5-3	Compliance audit and performance review	The proponent shall make the reports required by condition 5-2 publicly available, to the requirements of the EPA.	Available on Department of Water website: < <a href="http://www.water.wa.gov.au">www.water.wa.gov.au</a> >	Reports made available on the Department of Water website: < <a href="http://www.water.wa.gov.au">www.water.wa.gov.au</a> >	CEO		Overall	After OEPA acknowledgement letter being received. Department of Water website.	<b>Compliant.</b> The following Jandakot compliance reports can be found on the department's website < <a href="http://www.water.wa.gov.au">www.water.wa.gov.au</a> >: • 2006–07 annual (DoW 2007b) • 2005–08 triennial (DoW 2008a) • 2008–09 annual (DoW 2009b) • 2009–10 annual (DoW 2010) • 2008–11 triennial (DoW 2012a) • 2011–12 annual (DoW 2012b) • 2012–13 annual (DoW 2013)

Audit code	Subject	Action	How	Evidence	Requirement of	On advice from	Phase	When/Where	Status
688: M 5-4	Compliance audit and performance review	The proponent shall report any breach or anticipated breach of the environmental criteria set out in tables 1 and 2 (attached to statement 688) or environmental objectives to the OEPA immediately it becomes evident to the proponent.	Report in regular summaries sent to the Chief Executive Officer of the OEPA.	Letter to the Chief Executive Officer of the OEPA reporting non-compliance with water level and other criteria as required. Compliance report.	CEO		Overall	Immediately as it becomes evident.	<b>Compliant.</b> The department reports to the OEPA to inform non-compliance with criteria water levels and other criteria.
688: M 6-1	Management plan	The proponent shall implement the Environmental Management Plan prepared by the Water Authority of Western Australia (1992) to the requirements of the EPA.	Comply with environmental objectives and criteria listed in WAWA EMP (1992).	Compliance report	EPA		Overall		<b>The Department of Water seeks advice on 'clearing' this condition.</b> The condition to implement the requirements set out in the Environmental Management Plan are covered and met by water level, environmental monitoring and management commitments in Ministerial Statement No. 688. The Environmental Management Plan was submitted to the Department of Environment and Conservation (now the OEPA) in 1992 and since then there have been a number of amendments to Ministerial conditions relating to the plan. The department considers the implementation of the Environmental Management Plan an ongoing commitment. From 2005 onwards the Department of Environment, now Department of Water has been demonstrating its implementation through annual/triennial compliance reports to the OEPA. Implementation is reported as: <ul style="list-style-type: none"> <li>compliance with water level and other criteria</li> <li>predictions of non-compliance with water level criteria</li> <li>reporting on proponent and Ministerial conditions/commitments (audit tables)</li> <li>implementation of the environmental monitoring program (required under other conditions).</li> </ul>
688: M 7-1	Groundwater allocations	The proponent shall inform the EPA immediately of any proposed changes to allocations, abstraction limits and licence or allocation periods.	Detail limits on availability on the Department of Water website. <www.water.wa.gov.au> Detailed in annual/triennial reports.	Reports made available on the Department of Water website: <www.water.wa.gov.au>	Minister for the Environment		Overall		<b>Compliant.</b> Documented in annual and triennial compliance reports. There has been limited change (mostly reductions in abstraction) over the last five years. The department's recent management focus has been an allocation limit review for the Jandakot Groundwater Area (see Section 6.2.1). The OEPA will be consulted regarding changes that have resulted from the review.
688: M 8-1	Water conservation	The proponent shall actively encourage further reduction in public and private water demand in accordance with the State Water Strategy (2003) and other water conservation initiatives.	Engage in activity that supports water conservation.	Compliance reports	Minister for the Environment		Overall		<b>Compliant.</b> Section 6 outlines management actions the department is undertaking to encourage further reduction in public and private water demand. Following extensive consultation with the irrigation industry as well as local government, the Department of Water developed and implements <i>Operational policy no. 1.2 – Policy on water conservation/efficiency plans</i> (DoW 2009c). The department's Water Recycling and Efficiency staff undertake projects (see Section 6.2.3) to reduce water demand and achieve water conservation initiatives. This includes implementing <i>Operational policy no. 1.2 – 'Policy on water conservation/efficiency plans'</i> and implementing the permanent winter sprinkler ban.
688: M Procedure 1		Where a condition states 'to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority', the EPA will prepare the written notice to the proponent.	The EPA to provide written notice to the proponent (Department of Water).		Minister for the Environment		Overall		Not the responsibility of the Proponent.
688: M Procedure 2		The EPA may seek advice from other agencies or organisations, as required, in order to provide its advice.	The EPA to seek advice as required.		EPA	Other agencies as required	Overall		Not the responsibility of the Proponent.
688: M Procedure 3		Where a condition lists advisory bodies, it is expected that the proponent will obtain the advice of those listed as part of its compliance reporting to the EPA.	Department of Water liaises with advisory body as required.	Liaison with advisory body in compliance report	EPA	Agencies listed as part of compliance reporting	Overall		<b>Compliant.</b>

**Table 2 Proponent environmental management conditions**

Audit code	Subject	Objective	Action	How	Evidence	Requirement of	On advice from	When/Where	Status
688: P 1	Groundwater-dependent ecosystems	To protect significant environmental values.	Ensure that groundwater abstraction satisfies the environmental criteria presented in tables 1 and 2 ( <i>Ministerial Statement No. 688</i> ).	Meet objectives and Environmental Water Provisions criteria presented in Tables 1 and 2 ( <i>Ministerial Statement No. 688</i> ).	Compliance report.	Minister for the Environment		Overall	<b>Partly compliant.</b> Detailed in report, refer to results given in Appendix A .
688: P 2 1	Environmental management and monitoring	To minimise environmental and/or significant impact.	In the event that monitoring indicates that there will be significant impacts of a nature not predicted or indicates that a breach of the specified criteria has occurred or is likely to occur, then one or more of the following actions will be undertaken: 1. demonstrate to the satisfaction of the EPA that the breach of criteria is not a result of groundwater abstraction; or	Review of monitoring results, advice from expert hydrogeologists, groundwater modelling.	Compliance report. See Condition 688: M 5-4	EPA		Overall	<b>Compliant.</b> The department predicts the sites that are likely to be non-compliant with water level criteria during the coming summer. The department uses these predictions to review public water supply abstraction to limit impacts at Ministerial sites.
688: P 2 2	Environmental management and monitoring	To minimise environmental and/or significant impact.	2. satisfy the EPA that the breach of a criterion is transient and not of permanent significance; or	Review of similar occurrence in the past and consequences from environmental monitoring results Advice from expert hydrogeologists.	Compliance report	EPA		Overall	<b>Partly compliant.</b> Water levels at a number of Ministerial sites, including North Lake, Bibra Lake and Shirley Balla Swamp are consistently non-compliant with water level and other criteria. The department considered non-compliance and ecological condition at these in the review of allocation limits for the Jandakot Groundwater Area. The non-compliance at these sites is also considered in distributing public supply abstraction and in licensing decisions for private use.
688: P 2 3	Environmental management and monitoring	To minimise environmental and/or significant impact.	3. take the following actions: a. modify pumping from any bore where such changes can have a measurable effect (say raise water levels 1 centimetre or more), except in extenuating circumstances such as where significant economic hardship would occur, or CALM declare that the low water levels would be beneficial b. in the case of a wetland, artificially maintain the 'action minima' water level c. implement a short-term detailed monitoring program to establish the condition of agreed species in the affected area.	Implement actions as outlined.	Compliance report	EPA		Overall	<b>Compliant.</b> No new actions were required in the reporting period. As described in previous compliance reports, the department restricts Water Corporation abstraction from bores that impact on Ministerial sites and other groundwater-dependent ecosystems.
688: P 3	Water allocation	To minimise environmental and/or significant impact and manage the resource sustainability.	Regularly review the bulk allocations for private abstraction, as part of the total water abstraction allocation for the Jandakot PWSA, with regard to the sustainable yield of the superficial aquifer, including consideration of the environmental impacts of that abstraction.	Make part of Department of Water, water allocation planning program.	Compliance report	EPA		Overall	<b>Compliant.</b> The department's recent management focus has been an allocation limit review for the Jandakot Groundwater Area (see Section 6.2.1). This review considered allocations for both private and public abstraction.
688: P 4	Water allocation	To minimise environmental and/or significant impact and manage the groundwater resource sustainability.	Restrict the issuing of licences for private abstraction to the limits set by the bulk allocations for both the Jandakot PWSA in its entirety and the licensing subareas.	Set sub-area groundwater allocation limits to values equal to or less than those set for the Jandakot PWSA.	Compliance report	EPA			<b>Compliant.</b> Total private licensed entitlements are below allocation limits originally set for subareas of the Jandakot Groundwater Area (see Table 3). The department's recent management focus has been an allocation limit review (see Section 6.2.1). The review sets new limits across subareas of the Jandakot Groundwater Area.
688: P 5	Water allocation	Provide up-to-date mechanisms for groundwater allocation.	Investigate and implement efficient mechanisms for groundwater allocation.	Incorporate in regular Department of Water water allocation work program.	Compliance report	EPA			<b>Compliant.</b> The department's recent management focus has been an allocation limit review (see Section 6.2.1). This review used contemporary methods for determining sustainable limits.
688: P 6	Groundwater protection	To minimise environmental and/or significant impact and manage the groundwater resource sustainability.	Assist the EPA in the development of environmental protection policies to protect groundwater.	Liaise with the EPA as required	Compliance report	EPA			<b>N/A at this time.</b>

Audit code	Subject	Objective	Action	How	Evidence	Requirement of	On advice from	When/Where	Status
688: P 7	Groundwater protection	Integrated land and water resource planning to minimise environmental and/or significant impact.	Participate in the review of regional plans proposed by the Department for Planning and Infrastructure, local government town planning schemes, and rezoning and development applications.	Liaise with local government, the Department for Planning and Infrastructure, and other relevant land-use planning agencies.	Compliance report	EPA			<b>Compliant.</b> The department assesses land use proposals with potential water resource issues referred from local and state government agencies. In partnership with the Department of Planning (and other agencies), the department produced the <i>Better urban water management</i> publication (WAPC 2008). The department also recently produced the <i>Jandakot drainage and water management plan</i> (DoW 2009d) which aims to assist land developers and local government to better manage groundwater quantity and quality. The department recently provided advice on the <i>South Metropolitan and Peel regional structure plan - Regional water management strategy</i> which identifies water related constraints and opportunities associated with proposed urban/industrial areas.
688: P 8	Groundwater protection	Integrated land and water resource planning to minimise environmental and/or significant impact.	Participate in the review of development submissions to the EPA.	Provide advice to the EPA as requested.	Compliance report. See 688: P 7	EPA			<b>Compliant.</b> See 688: P 7
688: P 9	Groundwater protection	Integrated land and water resource planning to minimise environmental and/or significant impact.	Work with the Department for Planning and Infrastructure to prepare an integrated Land Use and Water Management Strategy for the Jandakot Mound.	Liaise with the Department of Planning and Infrastructure to prepare an integrated Land Use and Water Management Strategy for the Jandakot Mound.	Compliance report	EPA			<b>Compliant.</b> The department recently produced the <i>Jandakot drainage and water management plan</i> (DoW 2009d) which aims to assist land developers and local government to better manage groundwater quantity and quality. With the Department of Planning (and other agencies) the department has produced the <i>Better urban water management</i> publication (WAPC 2008). The department recently provided advice on the <i>South Metropolitan and Peel regional structure plan - Regional water management strategy</i> which identifies water related constraints and opportunities associated with proposed urban/industrial areas.
688: P 10	Water conservation	Water conservation.	Actively pursue programs in both supply and demand management. This includes ongoing public information programs and, where appropriate, regulation for design changes and regular reviews of pricing to conserve water. Improvements in the Water Corporation's supply system will also be pursued.	Engage in activity that supports water conservation. Development of a policy on water conservation plans.	Compliance report	EPA			<b>Compliant.</b> Section 6.2.3 outlines actions the department is undertaking to pursue supply and demand management and support water conservation.
688: P 11	Groundwater protection	Integrated land and water resource management to minimise environmental and/or significant impact.	Actively participate in integrated management of the Jandakot catchment.	Liaise with other water and land-use agencies.	Compliance report	EPA			<b>Compliant.</b> The department liaises with other water and land-use agencies in integrated management of the Jandakot catchment including the Water Corporation, OEPA and the Western Australian Planning Commission. For example, the department, with some modelling assistance from the Water Corporation, prepared the <i>Jandakot drainage and water management plan</i> for the (WAPC) Jandakot structure plan area (see 688: P 9).
688: P 12	Environmental management and monitoring	Environmental management of groundwater abstraction is based on best available scientific knowledge.	Review and revise the management criteria and strategies, with the agreement of the EPA, as knowledge of the Jandakot environment and its interaction with groundwater improves.	Stage 1 and 2 Section 46 review supported by scientific research results.	Compliance report	EPA	EPA		<b>Compliant.</b> <i>Stage I Section 46</i> completed and a number of changes were supported by the OEPA (refer Bulletin 1155). <i>Stage II Section 46</i> work has concentrated on the Gngangara Mound area due to priorities (refer 2007-08 Gngangara compliance report, December 2008). The department's recent management focus has been an allocation limit review for the Jandakot Groundwater Area (see Section 6.2.1).
688: P 13	Environmental management and monitoring	Monitor compliance with Ministerial water level criteria. Management of groundwater levels to protect environmental values of select wetlands.	Monitor water levels in groundwater monitoring bores and North, Bibra, Yangebup, Kogolup, Thomsons and Forrestdale lakes, and The Spectacles and Twin Bartram Swamp, as well as some other small wetlands.	Include in Department of Water regional groundwater monitoring program.	Compliance report. Hydrographs available on the Department of Water website: <www.water.wa.gov.au> See 688: P 14	EPA			<b>Compliant.</b> Detailed in the annual report, refer to the results given in Appendix A. Wetlands were included in the department's Jandakot Environmental Monitoring Program referred to the EPA in December 2005 (see 688: P 14). Hydrographs of Ministerial criteria wetland and terrestrial vegetation sites are available on the department's website.



Audit code	Subject	Objective	Action	How	Evidence	Requirement of	On advice from	When/Where	Status
688: P 14 1	Environmental management and monitoring	Provide a means for the assessment of compliance with Ministerial environmental criteria for the Jandakot Mound.	1. Prepare an environmental monitoring program for submission to the EPA for review and subsequent finalisation of the program to the satisfaction of the EPA. The monitoring program will include: <ul style="list-style-type: none"> <li>• monitoring of groundwater levels in all relevant aquifer systems</li> <li>• relevant wetland water levels and water quality</li> <li>• condition of vegetation and fauna associated with groundwater-dependent ecosystems.</li> </ul>	Prepare an environmental monitoring program.	Submit monitoring program to the EPA for approval. Compliance report.	EPA	DEC	Within four months of a revised statement being issued following the 2004 Stage 1 section 46 review	<b>Compliant.</b> The department's monitoring program includes: <ul style="list-style-type: none"> <li>• monitoring of groundwater levels in all relevant aquifer systems</li> <li>• relevant wetland water levels and water quality</li> <li>• condition of vegetation and fauna associated with groundwater-dependent ecosystems.</li> </ul> The previous environmental monitoring program was produced and submitted to the EPA on 21 December 2005. It was detailed in Appendix 7 of Gngangara Triennial report 2003–06 (DoW 2007a). The audit of 2006–07 compliance report agreed commitment could be 'cleared' upon confirmation from the DEC. A review of the environmental monitoring program was undertaken in June 2009 in collaboration with the ecologists who undertake the monitoring (see Appendix D). A number of amendments were made. A letter was sent to Director General of the DEC in December 2009, seeking advice and input on the amendments. Further revisions may result from recommendations from the Perth shallow groundwater systems investigations and the eco-hydrological states investigation (see Section 6.3).
688: P 14 2	Environmental management and monitoring	To enable assessment of compliance with Ministerial environmental criteria for the Jandakot Mound.	2. Implement the approved environmental monitoring plan	Make part of annual departmental work program	Compliance report	EPA	DEC		<b>Compliant.</b> A summary of the results of the environmental monitoring conducted over the reporting period (2011–14) is reported in Section 6.1. These results are used to distribute public supply abstraction to limit environmental impacts and inform licensing decisions for private use. The results were considered in the review of allocation limits in the Jandakot Groundwater Area.
688: P 14 3	Environmental management and monitoring	Monitoring program is a reflection of the best available knowledge of groundwater/environment interaction.	3. Review and revise the program every six years (coinciding with triennial reports), to the satisfaction of the EPA.	Incorporate review in triennial reporting in 6 year intervals.	Triennial compliance report	EPA	DEC	Every six years (coincide with Triennial report)	<b>Compliant.</b> A review of the environmental monitoring program was undertaken in June 2009 in collaboration with the ecologists who undertake the monitoring (see Appendix D). A number of amendments were made. A letter was sent to Director General of the DEC in December 2009, seeking advice and input on the amendments. Further revisions may result from recommendations from the Perth shallow groundwater systems investigations and the eco-hydrological states investigation (see Section 6.3).
688: P 15	Environmental management and monitoring	Monitor habitat shifts in conjunction with the assessment of potential impacts on environmental values from groundwater abstraction on the Jandakot Mound.	Use aerial photographs or equivalent on a triennial basis to detect habitat shifts in North Lake, Yangebup, Kogolup, Thomsons and Forrestdale lakes.	Aerial photographs not an effective method. Instead the department focuses on field surveys of vegetation transects.	Triennial compliance report	EPA		Every three years (coincide with Triennial report)	<b>Partly-compliant.</b> There may be limited value for use of aerial photos solely as a diagnostic tool. This was recognised and the commitment modified in Bulletin 1155. The department undertakes monitoring at established transects annually at each of these wetland sites. This monitoring identifies shifts in habitat. The department commissioned Edith Cowan University to develop a model for determining ecological risk to groundwater dependent vegetation in a drying climate. The model is based on 30 years of ecological and hydrological monitoring data. It will be an important management tool for assessing risk to groundwater dependent vegetation (including likely habitat shifts) under different climate and abstraction regimes.
688: P 16	Community consultation	Inform major stakeholders of Department of Water and Water Corporation activities on the Jandakot Mound. Provide mechanism for feed-back.	Hold meetings at least annually with the Jandakot Community Consultative Committee (JCCC) established in consultation with the EPA. This committee will be informed on the groundwater scheme's operation and will provide feed-back to the proponent.	Department of Water to organise JCCC meetings.	Compliance report	EPA			<b>Compliant.</b> The Jandakot Community Consultative Committee met in August each year of the reporting period and discussed environmental management of abstraction from the Jandakot groundwater system. A wide range of major stakeholders were represented at the meetings.
688: P 17	Community information	Maintain good public image and up-to-date knowledge of community concerns of water resource issues.	Continue to monitor community response to relevant water resource issues as reported by the media and maintain the current practice of public accessibility of WRC staff. Upon request and adequate notice, staff will address community groups on issues associated with groundwater management.	Monitor media for relevant issues. Address community groups as requested.	Compliance report	EPA			<b>Compliant.</b> The department subscribes to the 'Media Watch' service, which forwards newspaper articles relating to water resource issues to department employees. The department's staff are involved in conferences, meetings, and workshops that include community group representation (for example JCCC meetings).
688: P 18	Environmental management and monitoring	Improved environmental monitoring facility at this significant wetland.	Install monitoring wells and improved wetland water level monitoring facilities for Forrestdale Lake, and evaluate monitoring data to determine groundwater/wetland water level relationship. Subject to CALM/WRC installing permanent vegetation monitoring transect and undertaking flora and fauna studies to establish environmental values, the proponent will review available information to propose revised management criteria, if appropriate.	Being addressed as part of the Department of Water project 'Perth shallow groundwater systems investigation'.	Compliance report	EPA			<b>Compliant.</b> Groundwater monitoring bores were installed at Lake Forrestdale (Bourke 2008) and North Lake (Searle 2009) as part of the Perth shallow groundwater systems investigation. The Spectacles and Thomsons Lake were also included (Searle 2009) with sampling undertaken at existing bores (see Section 6.3). Monitoring data at these wetlands is being evaluated to determine groundwater/wetland water level relationship.



Audit code	Subject	Objective	Action	How	Evidence	Requirement of	On advice from	When/Where	Status
688: P 19	Environmental management and monitoring	Enable good water resource management including environmental protection on the Jandakot Mound.	<ol style="list-style-type: none"> <li>1. Prepare a Management and Monitoring Program.</li> <li>2. Implement the Management and Monitoring Program.</li> </ol>	Prepare Management and Monitoring Program and submit to EPA.		EPA		Completed	<p><b>Completed.</b>  <b>The Department of Water seeks advice on 'clearing' this condition.</b>  This commitment was required prior to commissioning of the Stage 2 scheme. Stage 2 has been in operation for over 10 years and the implementation of the management and monitoring program has been described in numerous annual and triennial compliance reports. In addition, following publication of <i>Ministerial Statement No. 688</i>, a revised monitoring program was developed and submitted to EPA (refer Commitment 688: P 14) in December 2005.</p>
688: P 20		Improve understanding of groundwater/wetland ecology relationships	Continue to fund the research projects 10.6.3 listed in Appendix 2 of the EPA Bulletin 587 for the duration of the studies.	Include research projects in annual business planning.		EPA		Completed	<p><b>Completed.</b>  <b>The Department of Water seeks advice on 'clearing' this condition.</b>  Auditor's comments in the 2003–04 annual report state commitment can be 'cleared'. Research projects given in Appendix C (Table A12.2) of EPA <i>Bulletin 587</i> refer to commitments given in numbers 21, 22, and 23 below.</p>
688: P 21		Improve understanding of aquatic fauna of the select Jandakot wetlands.	<p>Develop a fauna monitoring program which will focus on:</p> <ol style="list-style-type: none"> <li>1. waterbird species diversity and breeding success</li> <li>2. the number of families of aquatic invertebrate and, at infrequent intervals, species richness.</li> </ol>	Develop a fauna monitoring program.		EPA	CALM	Completed	<p><b>Completed.</b>  <b>The Department of Water seeks advice on 'clearing' this condition.</b>  Auditor's comments in the 2003–04 annual report agreed such a program had been developed prior to commissioning of the Stage 2 scheme and implemented and that the commitment can be 'cleared'. Fauna monitoring program has been developed and results presented in numerous annual and triennial reports to date.</p>
688: P 22		Improve understanding of the environmental significance of this wetland and means of protecting values.	Undertake study of Banganup Lake, in conjunction with CALM and The University of WA to establish management criteria and consider effectiveness of artificial maintenance of water levels.	Undertake a study of Banganup Lake as described.		EPA	CALM	Completed	<p><b>Completed.</b>  <b>The Department of Water seeks advice on 'clearing' this condition.</b>  Study undertaken and Auditor comments in 2003–04 annual report states that Commitment can be 'cleared'.</p>
688: P 23		Improve understanding of the environmental significance of this wetland and means of protecting values.	Undertake a study of Twin Bartram Swamp to consider the feasibility and effectiveness of artificial maintenance of water levels.	Undertake a study of Twin Bartram Swamp as described.		EPA	CALM	Completed	<p><b>Completed.</b>  <b>The Department of Water seeks advice on 'clearing' this condition.</b>  Study was undertaken and Auditor's comments in 2003–04 annual report state that the commitment can be 'cleared'.</p>

## Appendix C – Background information

In 1988, the Water Authority of Western Australia (WAWA) referred plans for the construction of Stage 2 of the Jandakot Groundwater Scheme to the Environmental Protection Agency (EPA). The EPA applied a Public Environmental Review (PER) level of assessment to the proposal. In 1992, the Minister for the Environment issued a statement (EPA Bulletin 587, *Ministerial Statement No. 253 – Assessment 196*) advising that the proposal could be implemented subject to conditions and commitments imposed on the WAWA. The majority of these conditions and commitments relate to ensuring that groundwater and surface water levels across the Jandakot Mound are maintained at acceptable levels.

A key element of *Ministerial Statement No. 253* was confirming environmental water provisions for the maintenance of environmental values on the Jandakot Mound. These were set in the form of water level criteria to be achieved in key wetlands and other groundwater-dependent ecosystems such as areas of phreatophytic vegetation and rare flora.

In 2001, as a consequence of changes in land use and lower rainfall, the EPA endorsed a two-stage approach to review of the Ministerial conditions and commitments for the Gngangara and Jandakot mounds under section 46 of the *Environmental Protection Act, 1986*.

The first stage was for the department (then Department of Environment) to review Ministerial conditions and commitments on Gngangara and Jandakot based on existing knowledge (DoE 2005). This review led to *Statement No. 687* for Gngangara (Government of Western Australia 2005a) and *Statement No. 688* for Jandakot (Government of Western Australia 2005b), released in 2005.

The department conducted a further review of Ministerial conditions and commitments on Gngangara in 2007 (DoW 2008b). The purpose of this review was to refine Ministerial criteria sites to those with significant ecological value and those where abstraction is the main factor influencing groundwater levels. This review led to the *EPA Bulletin 1324* in May 2009, with recommendations to the Minister for Environment on the proposed changes. *Statement No. 819* (Government of Western Australia 2009a) for Gngangara was released later that year containing the consolidated and refined conditions and commitments.

The second stage of the section 46 review was proposed as a more comprehensive review to improve management of public and private abstraction and to incorporate ecological information from work underway at the time. This work has been subsequently overtaken by more recent investigations into the shallow groundwater systems and ecological responses to climate. Analysis of this investigative work will be used to focus management effort on those areas which will show the most benefit from changes to abstraction.

The intent of the stage two review will be covered by the next phase of planning for Gngangara groundwater resources. For Jandakot, analysis of this investigative work will be used to focus management effort on those areas which will show the most benefit from changes to abstraction.

## Appendix D – Review of environmental monitoring program (688: P 14 1)

In mid-2009, the department commenced a series of workshops to review monitoring in collaboration with the ecologists contracted to carry out the monitoring. The workshops aimed to improve both the effectiveness and efficiency of the monitoring program. In revising the monitoring program we:

- refocused the program on the relationships between groundwater levels, ecological condition and abstraction
- improved the efficiency of our monitoring by reducing the monitoring frequency from annually to every three years, unless annual monitoring is warranted on a management or information-needs basis
- improved the presentation and communication of monitoring data.

A second review workshop, held in late April 2010, considered the following two key issues:

- how monitoring results could be presented spatially so that they represent short-term and long-term trends across an entire groundwater management area
- how modelling results could be used to ensure the monitoring effort is focussed on the correct areas in the long-term.

The main outcomes and recommendations of this workshop were:

- Future monitoring programs should include sites where improvements in ecological health and compliance are possible through managing abstraction (based on modelling).
- The department can make a difference to important areas on the Jandakot Mound by managing abstraction – even minor benefits to groundwater levels can be significant for certain groundwater-dependent ecosystems.
- Where possible, abstraction should be reduced in areas where it would benefit wetlands that still retain some of their key environmental values.

Another review was held in 2013 to further refine the frequency of the monitoring program.

## Appendix E – Map information and disclaimer

### **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

### **Project information**

Client: R.Rowling

Map Author: S.Edgar

Task ID: 0012

Filepath:

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Filename: C2207

Compilation date: November 2013

### **Disclaimer**

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While the Department of Water 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.

### **Sources**

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

Western Australia Towns – DLI – 12/07/2001

WA Coastline, WRC (Poly) – DoW – 13/10/2000

Hydrography, Linear (Hierarchy) – DoW – 05/11/2007

RIWI Act, Groundwater Areas – DoW – 06/03/2008

Road Centrelines - DLI - 09/20208

RIWI Act, Groundwater Areas - DoW - 06/03/2008

Groundwater Subareas - DoW - 11/03/2009

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