Government of **Western Australia**
Department of **Water and Environmental Regulation**

Environmental management of groundwater from the Jandakot Mound

Triennial compliance report
July 2014 – June 2017

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Department of Water and Environmental Regulation

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This publication is available at our website <dwer.wa.gov.au> *or for those with special needs it can be made available in alternative formats such as audio, large print, or Braille.*

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1 Summary

The Department of Water and Environmental Regulation (DWER) was established by the Government of Western Australia on 1 July 2017. It is a result of the amalgamation of the Department of Environmental Regulation, Department of Water and the Office of the Environmental Protection Authority. This report contains references to previous government departments and programs.

This report describes the Department of Water's compliance with Ministerial conditions and commitments for the Jandakot Mound for the period 1 July 2014 to 30 June 2017 under *Ministerial statement no. 688: Jandakot Mound groundwater resources* (Government of Western Australia 2005a). The report also outlines the environmental monitoring, management, research and consultation the department is doing to improve sustainable management of the Jandakot groundwater system.

Rainfall over the three year period was well below the long-term average, but improved in 2015–16 and 2016–17, and was close to the 10 year average at the Jandakot Airport station in these years.

From 2014–15 to 2015–16, non-compliance with absolute minimum water level criteria increased from three to five sites, with Shirley Balla Swamp and Banganup Lake returning to non-compliance and remaining non-compliant in 2016–17. However, in 2016–17 the number of sites non-compliant with the absolute minimum water level criteria reduced to four, with minimum levels at Lake Forrestdale compliant for the first time since 2009–10.

Public water supply abstraction from the Superficial aquifer increased in 2015–16, with an additional 1.3 GL licenced for public water supply as part of a two-year trial to confirm if the volume could be taken sustainably. The trial volume was reduced to 1 GL for 2016–17 in response to the additional non-compliances at Shirley Balla Swamp and Lake Banganup, with bores closest to these sites targeted during the reductions. We are currently assessing continuation of the additional licence.

Although total private licensed abstraction increased across the Jandakot Mound by 1.1 GL over the reporting period, most of this volume was abstracted in subareas that do not affect non-compliant sites.

Table 1 Rainfall, licensing totals and compliance with Ministerial criteria

	2014–15	2015–16	2016–17
Rainfall[1]	673.4 mm	745.3 mm	739.8 mm
Public water supply entitlements	2.90 GL	4.20 GL	3.90 GL
Private licensed entitlements	36.27 GL	37.39 GL	37.37 GL
No. of non-compliant sites[2]	3 out of 23	5 out of 23	4 out of 23

1 Rainfall figures are for July–June and taken from Jandakot Airport (BoM station no. 9172).

2 For full details of compliance see Table 4 and Appendix A.

2 Background

2.1 Ministerial statement no. 688

Ministerial statement no. 688: Jandakot Mound groundwater resources (Government of Western Australia 2005a) 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). Phreatophytic vegetation is vegetation that uses groundwater to meet at least part of its water needs.

Ministerial conditions and commitments were first established in 1992 to manage how groundwater is abstracted for public water supply and the expected growth in private licensed use. Since then, the conditions and commitments have been revised several times to remove sites where environmental values were lost due to causes other than abstraction (see Appendix A). 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 water level criteria at five sites. The water level criteria at the current sites represent contemporary environmental water provisions, suitable for protecting significant environmental values of groundwater-dependent ecosystems on the Jandakot Mound.

2.2 Allocation limits and licensing

The department uses allocation limits, licensing of groundwater abstraction and monitoring as the main mechanisms to manage groundwater resources. An allocation limit is the annual volume of water set aside for consumptive use from a water resource. This usually includes:

- water that is available for licensing
- water we account for that is exempt from licensing, including water used by domestic garden bores
- water we set aside for future public water supply.

Water for the environment is not included in the allocation limit as it is left in the system and considered a non-consumptive use. Allocation limits are set considering recharge estimates, modelling, environmental objectives and benefits of groundwater use. The limits guide water availability for individual licence assessments. The department also guides the appropriate use of domestic garden bores through sprinkler restrictions and identifying the areas that are unsuitable for the installation of new bores.

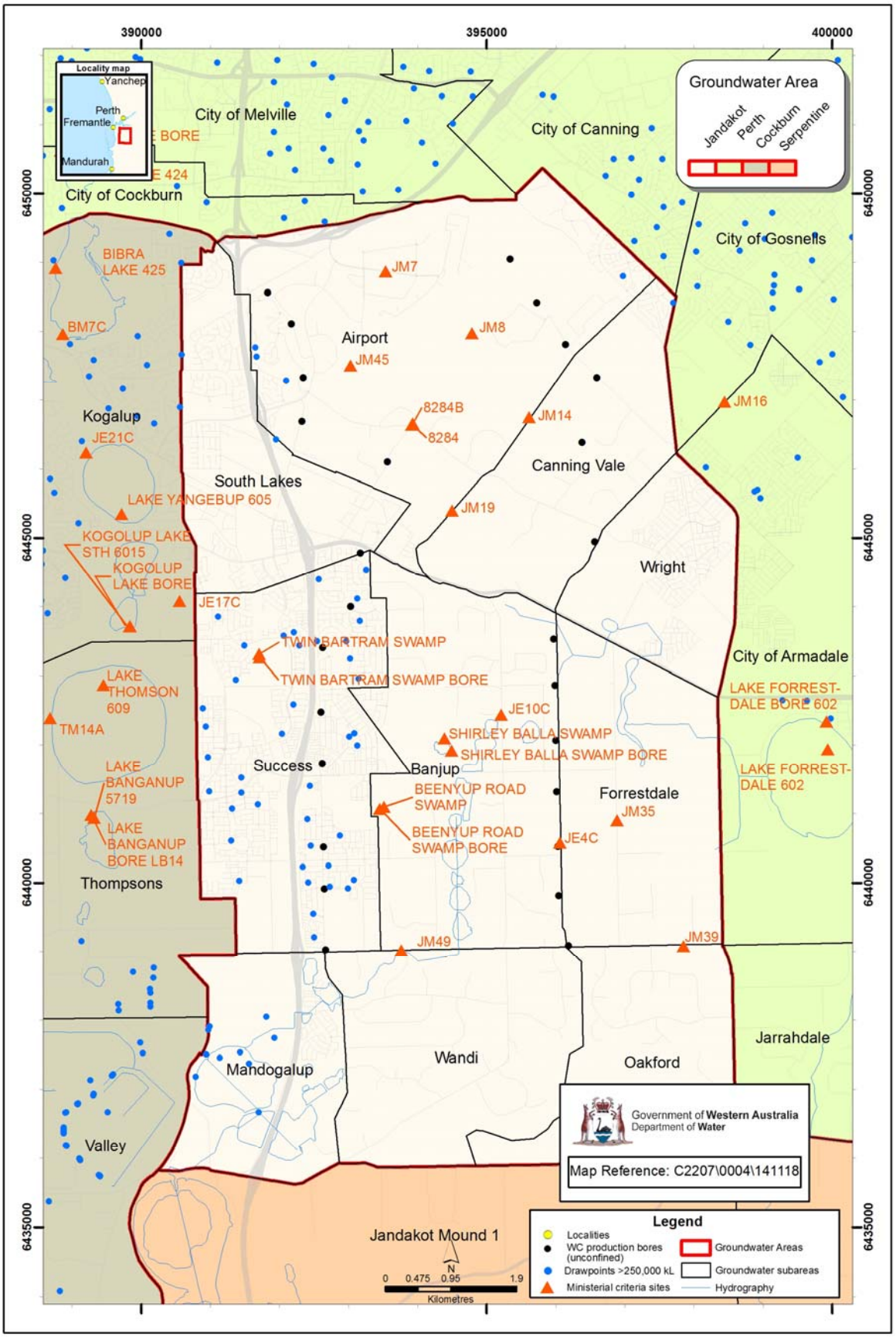

Figure 1 Location of Jandakot Ministerial sites, public water supply production bores and private licensed drawpoints

2.3 The Jandakot groundwater system

The Jandakot groundwater system is located south of Perth. It extends from Rockingham in the south to the Swan–Canning River in the north, and from the coast to close to the Darling Scarp in the east. The system comprises three main aquifers:

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

Most of the Jandakot Mound is separated from the deeper Leederville aquifer by a confining layer of Kardinya shale that extends under all of the Ministerial sites except Lake Forrestdale. This separation means that abstraction from the Superficial aquifer has a greater impact on Jandakot Mound wetlands than abstraction from the deep aquifers.

Groundwater levels across the Jandakot Mound have generally declined over the last 40 years, but at a slower rate than seen across the Gnangara Mound, north of the Swan River. In many areas of the Jandakot Mound water levels have improved over the last five years due to:

- annual rainfall being generally greater than the extreme dry years of 2006 and 2010
- localised management of abstraction
- increased recharge rates from urbanisation.

3 Rainfall

Groundwater levels in the Superficial aquifer depend on recharge from rainfall. Across south-west Western Australia there has been a general trend of declining annual rainfall since the mid 1970s (Figure 2). CSIRO's investigation of climate change (Bates et al. 2010), as well as other relevant climate models, predict continued rainfall declines in this region.

Rainfall at the Bureau of Meteorology's (BoM) Jandakot Airport station was:

- 673.4 mm in 2014–15
- 745.3 mm in 2015–16
- 739.8 mm in 2016–17.

All years were well below the long-term average (840.8 mm) though the improved rainfall totals in 2015–16 and 2016–17 were very close to the 10 year average (751.9 mm) (Figure 2).

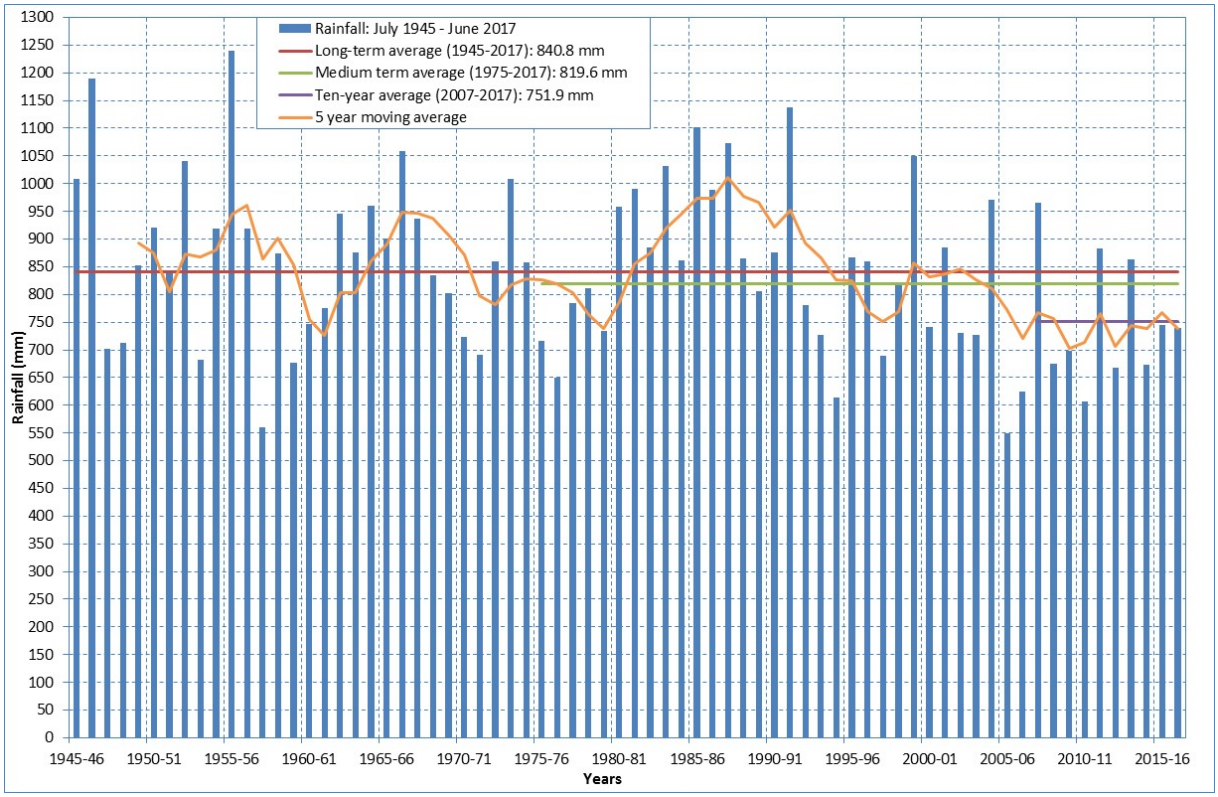

Figure 2 Annual and average water-year rainfall at Jandakot Airport (BoM site no. 9172)

4 Groundwater use

The Jandakot groundwater system provides water for public open space, agriculture, and industry, contributes to Perth's public water supply and supplies water for domestic garden bores.

This report summarises allocation limits, licensed entitlements and estimates of use exempt from licensing for subareas on the Jandakot Mound where groundwater abstraction impacts on Ministerial sites.

Most of the Ministerial sites are located in the Jandakot groundwater area with the remaining sites located in the Cockburn and the Perth South groundwater areas (Figure 1). The hydrogeology of the Jandakot Mound means that sites within the Jandakot groundwater area are most impacted by abstraction from within that area. Sites located in the Cockburn and the Perth South groundwater areas, to the west and east respectively, are also impacted by abstraction from the Jandakot groundwater area because groundwater flows from the Jandakot groundwater area into these areas. They are also impacted by local abstraction in the Cockburn and the Perth South groundwater areas.

4.1 Public water supply

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

In 2014–15 a total of 13.8 GL was licensed for public supply from all aquifers of the Jandakot system (Table 2). The totals in 2015–16 and 2016–17 increased to 17.05 GL and 17.75 GL respectively.

An additional volume of 1.3 GL from the Superficial aquifer was licensed in 2015–16. The volume was reduced to 1 GL for 2016–17 in response to additional non-compliances at Shirley Balla Swamp and Lake Banganup with the reductions targeted to bores closest to these sites. We are currently assessing whether this volume can be taken sustainably in the long term.

The increased volumes in 2015–16 and 2016–17 also included more water from the Yarragadee aquifer. This was made possible following Water Corporation's upgrade of the Jandakot Groundwater Treatment Plant, which allowed 6 GL/year to be abstracted from a relatively new bore in the Yarragadee aquifer. The presence of the Kardinya Shale means that volumes licensed from the Leederville and Yarragadee aquifers are unlikely to impact on wetlands on the Jandakot Mound.

Licensed entitlements for public water supply from the Superficial aquifer are further broken down into groundwater subareas in Table 2 (Section 4.3).

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

Aquifer	Public water supply entitlements (GL)		
	2014–15	2015–16	2016–17
Superficial	2.90	4.20	3.90
Leederville	6.45	6.40	6.90
Yarragadee[1]	4.45	6.45	6.95
TOTAL	13.80	17.05	17.75

1 Includes groundwater licensed from the new Yarragadee bore in the Jandakot groundwater area (3.80 GL in 2014–15, 5.75 GL in 2015–16 and 6 GL in 2016–17) and volumes licensed to bore MR17 in the Perth South groundwater area (0.65 GL in 2014–15, 0.7 GL in 2015–16 and 0.95 GL in 2016–17).

4.2 Private licensed use

Groundwater licensed for private use from the Jandakot system mostly comes from the Superficial aquifer and mainly includes parks, gardens and recreation, agriculture, industry and commercial uses.

Over the reporting period, private licensed entitlements from the Superficial aquifer increased by 1.1 GL (Tables 1 and 3). In the Jandakot and Perth groundwater areas the increases were within current allocation limits. However, the Wright subarea became temporarily over-allocated during 2015–16 due to approval of a short-term licence to help progress development in the area.

In the Cockburn groundwater area, allocation limits in the Kogalup and Thompsons subareas were reduced from 11.46 GL to 9 GL and 8.7 GL to 4.5 GL respectively. This followed a recent review of allocation limits, in line with the drying climate. Private licensed entitlements in these subareas exceeded the revised allocation limits over the reporting period, triggering a recoup of long-term unused entitlements.

Table 3 (section 4.3) shows private licensed entitlements for the groundwater subareas related to the Jandakot Ministerial sites.

4.3 Use that is exempt from licensing

When we review allocation limits, we estimate and account for groundwater that is exempt from licensing. To account for this volume we use:

- water use surveys and local knowledge
- estimates of the number of properties that are likely to have domestic bores, from local government plans and land zoning
- information on the subdivision potential of the properties (current and future)
- information on potential changes to recharge, such as from land-use changes (e.g. bushland developed into urban)
- water use and future requirements of Commonwealth government agencies.

In our 2015–16 allocation limit review for the Jandakot groundwater area we reviewed exempt use and also estimated the amount used across the whole of the Jandakot Mound. We found that 2.39 GL/year is abstracted for exempt uses, which is an increase from our previous estimate of 1 GL/year as a result of better accounting techniques for stock and domestic use on semi-rural and rural blocks.

The amount taken in the Jandakot groundwater area is about 10 per cent of the total estimated water use for exempt stock and domestic garden bores across the whole of the Jandakot Mound, which is estimated to be around 24 GL/year.

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

Groundwater area	Subarea	Ministerial criteria site present?	Allocation limit GL/year	Public water supply entitlements[4] GL				Private licensed entitlements[6] GL		
				2014–15	2015–16	2016–17	Future water reserve[5]	2014–15	2015–16	2016–17
Jandakot[1]	Airport	Yes	2.64	0.70	1.20	1.26	Yes	0.83	0.87	0.99
	Banjup	Yes	2.00	0.43	0.41	0.30	Yes	0.39	0.40	0.41
	Canning Vale	No	1.10	0.32	0.98	0.89	Yes	0.07	0.07	0.07
	Forrestdale	Yes	1.30	0.15	0.15	0.15	Yes	0.85	0.87	0.87
	Mandogalup	No	2.05					1.31	1.58	1.85
	Oakford	Yes	0.55					0.07	0.08	0.08
	South Lakes	No	0.82					0.57	0.57	0.53
	Success	Yes	3.91	1.30	1.46	1.30	Yes	0.99	1.19	1.02
	Wandi	No	0.88					0.30	0.31	0.31
	Wright	No	0.96					0.82	1.08	0.89
Total for Jandakot groundwater area			**16.21**	**2.90**	**4.20**	**3.90**		**6.19**	**7.01**	**7.03**
Perth[2]	City of Armadale	Yes	4.00					3.32	3.93	3.93
	City of Canning	No	3.50					2.74	2.74	2.58
	City of Cockburn	Yes	1.00					0.54	0.54	0.54
	City of Gosnells	No	5.50					3.35	3.28	3.32
	City of Melville	No	5.50					4.22	4.08	4.07
Total for Perth South groundwater area			**19.50**	**0.00**	**0.00**	**0.00**		**14.16**	**14.58**	**14.44**
Cockburn[3]	Kogalup	Yes	9.00					10.16	10.08	9.84
	Thompsons	Yes	4.50					5.75	5.73	6.06
Total for Cockburn groundwater area			**12.22**	**0.00**	**0.00**	**0.00**		**15.91**	**15.80**	**15.90**
Total for Jandakot subareas that affect Ministerial criteria sites			**47.93**	**2.90**	**4.20**	**3.90**		**36.27**	**37.39**	**37.37**

1 Allocation limits for the Jandakot groundwater area were updated in 2014–15.

2 Allocation limits for subareas in the Perth South groundwater area, to the south of the Swan River, were reviewed in 2007.

3 The allocation limits for the Cockburn groundwater were updated in January 2017.

4 Public water supply information is from both the department's Water Resources Licensing System and annual reports submitted to the department as a condition of the Water Corporation's licences.

5 Where groundwater is reserved for future public water supply, the reserve volumes are not included in the licensed entitlement figures presented. The reserved volumes were amended in a review of allocation limits in the Jandakot groundwater area in 2014–15.

6 For the period 2013–14 and 2014–2015 the source of private licensed entitlement data is the department's Water Resources Licensing System (2014–15 report run on 30 June 2015, 2015–16 report run on 1 July 2016, 2016–17 – allocation reports are normally captured at 30 June, however, as a result of upgrades to the licensing and reporting systems this year, allocation statuses were captured at 1 June 2017).

Also note:

- Up-to-date figures on water availability are available from the Department of Water and Environmental Regulation's Swan–Avon or Kwinana Peel regional offices.
- Figures are rounded to two decimal places.
- 1 GL = 1 000 000 kL.

5 Compliance

The conditions and commitments that DWER is required to comply with from *Ministerial statement no. 688: Jandakot Mound groundwater resources* (Government of Western Australia 2005a) are shown in Appendix A and B (the 'audit tables').

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. Some criteria 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 indicator for compliance from year to year
- levels allowed to fall between a preferred minimum and the absolute minimum in two out 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 time of drying – these are also referred to as 'other' water level criteria in this report.

In 2014–15 three of the 23 sites were non-compliant with absolute minimum water level criteria (Table 4) with two more sites (Banganup Lake and Shirley Balla Swamp) compliant compared to the previous year. In 2015–16 five sites were non-compliant with Banganup Lake and Shirley Balla Swamp returning to non-compliance. Both Shirley Balla Swamp and Banganup Lake remained non-compliant in 2016–17 but the number of sites non-compliant with the absolute minimum water level criteria reduced to four, with minimum levels at Lake Forrestdale compliant for the first time since 2009–10.

Four sites were non-compliant with 'other criteria' across the reporting period:

- North Lake
- Bibra Lake
- Lake Forrestdale
- Shirley Balla Swamp.

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

Table 4 Summary of Jandakot Mound sites non-compliant with Ministerial criteria

Year	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**
2014–15	North Lake Bibra Lake Lake Forrestdale	None	3 out of 23	Bibra Lake Thomsons Lake Lake Forestdale Shirley Balla Swamp	None	4 out of 12
2015–16	North Lake Bibra Lake Lake Forrestdale Shirley Balla Swamp Banganup Lake	None	5 out of 23	North Lake Bibra Lake Lake Forrestdale Shirley Balla Swamp	None	4 out of 12
2016–17	North Lake Bibra Lake Banganup Lake Shirley Bally Swamp	None	4 out of 23	North Lake Bibra Lake Lake Forrestdale Shirley Balla Swamp	None	4 out of 12

6 Environmental monitoring, management, research 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: Jandakot Mound groundwater resources* (Government of Western Australia 2005a).

The department reviewed the environmental monitoring program in 2009 and 2013 (see Appendix D) to improve cost effectiveness and efficiency. Over the reporting period the program included monitoring of:

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

Ecological condition is affected by a number of factors that influence water levels, including abstraction, fire, and disturbance from 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, reducing abstraction where it is likely to improve ecological condition.

Wetland vegetation

Over the reporting period the condition of wetland vegetation was monitored each spring at: Banganup Lake, North Lake, Beenyup Road Swamp, and Lake Forrestdale.

The following were also monitored in at least one spring over the period:

- Bibra Lake
- Twin Bartram Swamp
- Shirley Balla Swamp
- Thomsons Lake
- The Spectacles
- Kogalup Lake South.

In 2014–15 none of the wetlands monitored showed any concerning trends, with stable vegetation condition at all six sites. In 2015–16, water levels and wetland

vegetation condition declined compared to the previous year (Buller et al. 2016) at four sites (Beenyup Road Swamp, Shirley Balla Swamp, North Lake and Thomsons Lake). At these sites:

- canopy condition decreased at Beenyup Road Swamp
- there was increased exotic cover at North Lake
- there were changes in species composition at Beenyup Road Swamp.

The monitoring in 2014–15 found that fires had impacted Banganup Lake and Shirley Balla Swamp, significantly reducing canopy condition and causing the deaths of mature *Melaleuca preissiana* and *Eucalyptus rudis* at Banganup Lake, and at least 25 mortalities of *Melaleuca rhaphiophylla* and/or *M. preissiana* at Shirley Balla Swamp (Buller et al. 2016).

In 2016–17 there were minor increases in canopy condition at Beenyup Road Swamp, North Lake and Lake Forrestdale. There was also increased canopy condition at Shirley Balla Swamp due to continued regeneration from fire. A fire in 2015 had also impacted Kogalup Lake, with significant mortalities of *E. rudis* and *M. preissiana*, resulting in an 81 per cent reduction in canopy condition since the site was last monitored in 2013.

The 2016–17 monitoring also suggested Lake Banganup is at risk of changing ecological state, with a rapid decline of *Baumea articulata* (a wetland sedge) since 2008 (Buller et al. 2017).

Wetland macroinvertebrates and water quality

Over the reporting period macroinvertebrates and water quality were monitored in at least one spring at Thomsons Lake, Lake Forrestdale, Kogalup Lake South, Shirley Balla Swamp and Bibra Lake.

In 2014–15 water quality at all wetlands was within the expected ranges and water quality at Shirley Balla Swamp had improved from the acidic conditions found when the swamp was last sampled in 2009 with a neutral pH (7.05) recorded (Harms and Halse 2015).

In 2015–16 Kogalup Lake South was more alkaline than previously reported and Shirley Balla Swamp became more acidic, returning to the low pH levels seen before 2009. Forrestdale Lake and Shirley Balla Swamp contained more sulphur and sulphate while phosphate concentrations were comparable to the previous year (Harms and Curran 2016).

The monitoring in 2016–17 found that:

- Bibra Lake was poorly oxygenated with heavy loads of nitrogen and phosphorus
- Shirley Balla Swamp remained acidic (pH 5.23) with total phosphorus four times greater than the previous year

- Thomsons Lake was weakly acidic (pH 6.32) with total phosphorus doubling between 2014 and 2016
- water quality at Lake Forrestdale was generally within historic limits.

In 2014–15 macroinvertebrate richness was the highest ever recorded for all wetlands, especially at Shirley Balla Swamp. There was no significant change in macroinvertebrate composition compared with historic composition.

In 2015–16, invertebrate richness at Forrestdale Lake was slightly higher than the previous year and counts for Shirley Balla Swamp and Thomsons Lake were slightly lower. However, all counts were above the long-term mean recorded for these wetlands (Harms and Curran 2016).

In 2016–17 richness remained relatively constant at Lake Forrestdale and Thomsons Lake but declined at Shirley Balla Swamp. The reduced richness at Shirley Balla Swamp was likely due to changes in physicochemical parameters (pH, turbidity, declining water levels) (Mittra and Halse 2017).

Terrestrial vegetation

In 2016-17 health of phreatophytic vegetation was monitored at five sites on the Jandakot Mound

At all of the five monitoring transects there has been a general declining trend in groundwater levels, vegetation condition/health and abundance of both overstorey and understorey species since the baseline monitoring in 1988 (Syrinx Environmental PL 2017).

However, since 2011 there has been increases in minimum groundwater levels, improvements in health, and increases in abundance of many of the overstorey and understorey species monitored at all of the transects (Syrinx Environmental PL 2017).

6.2 Management actions

Managing public water supply

As outlined in the *Gnangara groundwater areas allocation plan* (DoW 2009a), the addition of the Southern Seawater Desalination Plant to the Integrated Water Supply Scheme triggered a change in how groundwater for public water supply is allocated. In line with the plan, the department has reduced groundwater allocations for the scheme from 145 to 120 GL/year from 2012–13 to 2016–17, from existing infrastructure on the Gnangara and Jandakot systems.

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

In 2014–15, 3.8 GL was abstracted from a new Yarragadee bore in the Jandakot Groundwater Area. The Water Corporation recently upgraded the Jandakot

Groundwater Treatment Plant, so that up to 6 GL can be taken. 5.75 GL was taken in 2015–16 and 6 GL in 2016–17. The presence of the Kardinya Shale means that volumes licensed from the Leederville and Yarragadee aquifers are unlikely to impact on wetlands on the Jandakot Mound.

In 2015–16 an additional 1.3 GL from the Superficial aquifer was licensed to the Water Corporation from the public water supply reserve as part of a two-year trial. The trial followed the department's review of allocation limits in the Jandakot groundwater area and has been designed to confirm sustainable volumes of abstraction. In response to the increase in non-compliance in 2015–16, we reduced the volume for the trial to 1 GL in 2016–17 and are currently assessing whether any additional licence will be continued.

Managing private licensed use

Private licensed use is monitored through on-ground compliance inspections, meter audits, water use surveys and the licence renewal process. Through this work we check that groundwater use is within licence entitlements and that site activities are authorised.

The department has prioritised its licence compliance and enforcement activities to consider the conditions and commitments in *Ministerial statement no. 688*. This included expanding the scope of our licensing compliance plan to focus on areas potentially affecting Ministerial sites.

The department also manages the use of groundwater by private licensees in other ways. This includes working with local governments, urban developers and other licensees that use large volumes, to improve water use efficiency, reduce demand for groundwater, assess water needs for future public open space, and assess water supply options.

Managing groundwater use exempt from licensing

Domestic garden bores are generally supported (where suitable and used efficiently) because they reduce demand on scheme water with minimal local impact. To help manage this abstraction, the department provides a garden bore use guideline that emphasises water conservation and efficiency. Further information on garden bore suitability can be found on the Perth Groundwater Map on the department's website.

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 as unsuitable in the bore suitability map.

To help preserve water resources and encourage 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 Act Exemption (Section 26C) Order 2007*. In 2010 the total winter sprinkler ban also came into effect under the *Water Agencies (Water Use) By-laws 2010*. These by-laws restrict the use of domestic garden bores to a roster of three days a week, with a total ban during winter.

The annual winter sprinkler ban is now in its eighth year and has become an accepted part of the community's water use calendar.

Jandakot groundwater area allocation limit review

In 2014–15 the department refined allocation limits for the Jandakot groundwater area. The changes to the allocation limits considered the drying climate and align with the environmental objectives in *Ministerial statement no. 688*. The new limits reduce the risk of abstraction causing an increase in non-compliance. The review has reduced the amount of groundwater available for licensing in the area by about 8 GL/year, without impacting on current groundwater entitlements.

Update of the Cockburn groundwater area water management plan

The department will be replacing the Cockburn groundwater area water management plan (DoW 2007a) in 2018. This was communicated to the public and stakeholders through an evaluation statement for Cockburn released in December 2016 (DoW 2016). A key objective of the updated plan is to meet Ministerial criteria at Bibra Lake, Lake Yangebup, Kogalup Lake, Thomsons Lake and Lake Banganup under a drying climate to 2030.

As part of this water allocation planning process the department reduced the allocation limits in the Superficial aquifer in January 2017. These refined limits are now in effect providing certainty to industry on the availability of groundwater and protecting environmental assets under the drying climate to 2030. A report outlining the method we used to update the allocation limits will be released in early 2018, at the same time as the plan for public comment.

The update to the Cockburn plan aligns with, and supports implementation of, the Western Trade Coast Heavy Industry Water Supply Strategy (DoW 2016b). The supply strategy outlines the cost and benefit of all water supply options for industrial growth in the area. These options include managed aquifer recharge, non-potable scheme supply such as wastewater reuse, and more efficient use of existing groundwater abstraction across the plan area.

6.3 Research initiatives

The department, together with research partners, is completing a number of major projects that will help us to continually improve and adapt how we manage groundwater resources.

Perth Regional Aquifer Modelling System

The department has recently updated the Perth Regional Aquifer Modelling System (PRAMS) and we are using it to model the interactions between climate, land use and groundwater abstraction. PRAMS was recently used to assess allocation limit options for the next water allocation plan for the Cockburn groundwater area.

Future climate tool

The department has developed a future climate tool that helps 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 provides robust, up-to-date and defensible climate science for our decision making.

A report outlining how we developed the climate tool is available on the department's website – *Selection of future climate projections for Western Australia* (DoW 2015a). We used the future climate tool in PRAMS modelling to assess allocation limit options against water level criteria at Ministerial sites for the next water allocation plan for the Cockburn groundwater area.

Perth Regional Confined Aquifer Capacity project

The department completed the four-year Perth Regional Confined Aquifer Capacity (PRCAC) project in 2016. The project investigated the best locations and depth for sustainable abstraction from the Leederville and Yarragadee aquifers and for groundwater replenishment (managed aquifer recharge). Outcomes of the $7 million project will ensure decisions about abstraction from the deep, mostly confined aquifers are based on robust, transparent science and collaboration with key stakeholders.

The project combined conventional hydrogeological investigations, innovative science from partnerships with leading research institutions, and ongoing collaboration with the Water Corporation. Outcomes of the project will help identify the best locations for abstraction and managed aquifer recharge to maximise abstraction from the deeper aquifers with acceptable impacts.

As part of this project a groundwater monitoring bore was constructed into the Leederville and Yarragadee aquifers in the vicinity of the Jandakot Mound at Woodman Point. This monitoring bore will improve our understanding of the confined aquifers in this area, serve as a long-term seawater intrusion monitoring bore, and ultimately improve our understanding and management of the groundwater system.

6.4 Consultation

The department regularly engages with the community through public seminars, conferences, workshops and community meetings, and presents annually to the Jandakot Community Consultative Committee (JCCC) as per our commitment in *Ministerial statement no. 688: Jandakot Mound groundwater resources.*

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.

Through the framework described in *Better urban water management* (WAPC 2008), we also provide advice to local governments and land development agencies on water management in urban areas to minimise the effects of drainage and stormwater on shallow groundwater in the Jandakot area. The framework sets out

how water resources should be considered at each planning stage by identifying the various actions and investigations required to support decisions at each level of planning.

Appendices

Appendix A — Water level monitoring results for Ministerial sites on the Jandakot Mound for 2006-2017

Bold text refers to compliance with water level criteria and other criteria, with **black bold text** for compliant sites and **red bold text** for non-compliant sites.

Table A1 Wetland sites

Wetland	AWRC reference number	Water level criteria (mAHD)		Other criteria	Water level (mAHD)											Comments on compliance during the 2014–17 reporting period
		Preferred	Absolute			2006–07	2007–08	2008–09	2009–10	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	
North Lake	Staff 6142521	13.29	12.68	<0.1 m decline per year	Max	13.18	13.07	13.22	12.93	12.68	12.93	12.71	13.01	13.11	12.79	12.95	Compliance and trends: **Non-compliant with absolute minimum criteria and other criteria.** The lake has been non-compliant with the absolute minimum criteria since 2006–07 and levels declined by more than 0.1 m from 2015–16 to 2016–17. The lake has dried in recent years. Management and mitigation: A shallow groundwater investigation finalised in 2014–15 improved our understanding of the lake's hydrogeology in relation to its ecological health. In 2014–15, we updated the allocation limits in the Jandakot groundwater area based on a review that considered compliance, water level trends and ecological heath at the lake. The lower allocation limits reduce the risk of future increases in abstraction impacting on lake levels. Additional information: The EPA did not support the Department of Water's recommendation (Strategen 2004) to revise the absolute minimum to 12.32 mAHD.
					Min	**12.38**	**12.38**	**12.38**	**12.38**	**12.38**	**12.27**	**12.30**	**12.30**	**12.30**	**12.00**	**12.30**	
	Bore 61410726				Min	**11.74**	**11.81**	**11.74**	**11.59**	**11.48**	**11.60**	**11.45**	**11.52**	**11.61**	**11.87**	**11.66**	
Bibra Lake	Staff 6142520	13.6–14.2 <15.0 peak	13.6	Dry no more than 2 in 3 years, and preferably less than 1 in 3 years	Max	14.5	14.3	14.3	14.2	13.7	14.0	13.9	14.3	14.3	14.0	14.1	Compliance and trends: **Non-compliant with absolute minimum and other criteria.** The lake has been non-compliant with the absolute minimum criteria and has dried every summer since 2006–07. Management and mitigation: In 2014–15, we updated the allocation limits in the Jandakot groundwater area based on a review that considered compliance, water level trends and ecological heath at the lake. The revised allocation limits reduce the risk of future increases in abstraction impacting on lake levels.
					Min	**13.5** dry 15/03	**13.5** dry 19/03	**13.5** dry 12/03	**13.5** dry 19/02	**13.5** dry 07/12	**13.5** dry 01/02	**13.5** dry 05/03	**13.5** dry 01/04	**13.5** dry 04/05	**13.5** dry 01/03	**13.5** dry 03/04	
	Bore BM7C 61410177	<15.0 peak			Min										**13.0**	**13.2**	
Kogalup Lake (South)	Staff 6142522	13.1–14.0 <14.8 peak	13.1	N/A	Max				15.2	14.5	14.8	14.6	15.1	15.2	14.6	14.9	Compliance: **Compliant with absolute minimum criterion.** Groundwater levels in 2014–15 were the highest recorded since 2009–10 and levels remained relatively stable over the reporting period.
					Min				14.0	14.0	14.0	13.8	14.1	14.4	13.8	13.9	
	Bore 6015 61410727				Max	14.6	14.5	14.9	14.5	14.5	14.8	14.6	15.1	15.2	14.6	14.7	
					Min	13.6	13.6	13.8	14.0	13.6	13.9	13.6	14.0	14.0	13.6	13.8	

Wetland	AWRC reference number	Water level criteria (mAHD)		Other criteria	Water level (mAHD)											Comments on compliance during the 2014–17 reporting period
		Preferred	Absolute			2006–07	2007–08	2008–09	2009–10	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	
Thomsons Lake	Staff 609 6142517	11.3–11.8	10.8	For 30% of time water levels > 11.8 mAHD (wet year – 10 %) 11.3-11.8 mAHD (medium year – 80 %) 10.8-11.3 mAHD (dry year – 10 %)	Max	11.5	12.4	12.7	12.7	12.1	12.3	12.2	12.5	12.4	12.2	12.6	Compliance and trends: **Compliant with absolute minimum criterion.** **Compliant with other criterion.** 2016–17 was classed as a dry year with 739 mm of rainfall received at Perth Airport (BoM station no. 9021). Levels were above 10.8-11.3 mAHD set for dry years. We are seeking clarification from the OEPA to confirm whether the BoM station should be used for rainfall data. The lake dries at 11.5 mAHD. Absolute minimum water levels are measured at the bore. Additional information: As part of the Jandakot Drainage Scheme, the Water Corporation monitors water levels at this site. The Department of Parks and Wildlife implements a supplementation and sampling analysis plan that it developed in 2004–05.
					Min	11.5 dry	11.5 dry	11.5 dry	11.5 dry	11.5 dry	11.5 dry	11.5 dry	11.5 dry	11.5 dry	11.5 dry	11.5 dry	
	Bore TM14A 61410367				Max	11.3	12.0	12.2	12.2	11.8	12.1	11.8	12.1	12.1	11.8	12.0	
					Min	11.1	11.3	11.2	11.3	11.0	11.2	11.4	11.2	11.2	11.1	11.3	
Lake Forrestdale	Staff 6162557	21.2–21.6	21.1	Preferred earliest drying by April (wet year), February to March (medium year) or January (dry year) Lake levels must be at least 0.9 m deep (22.6 mAHD)	Max	21.7	21.9	22.1	22.0	21.7	21.9	21.7	22.0	21.9	21.8	22.0	Compliance and trends: **Compliant with absolute summer minimum criterion in 2016–17.** 2016–17 is the first time the site has been compliant since 2010–11. **Non-compliant with other criterion.** The lake did not achieve a minimum depth of 0.9 m (22.6 mAHD) over the compliance period Management and mitigation: In 2014–15, we updated the allocation limits in the Jandakot groundwater area based on a review that considered compliance, water level trends and ecological heath at the lake. The revised allocation limits reduce the risk of future increases in abstraction impacting on lake levels. Additional information: The OEPA did not support a recommendation (Strategen 2004) to revise the absolute minimum to 20.2 mAHD.
					Min	**dry 25/10**	**dry 05/12**	dry 13/01	**dry 09/12**	**dry 07/12**	dry 11/01	dry 04/02	dry 04/01	dry 13/01	dry 11/01	dry 21/02	
	Bore 602 61410714				Max	22.9	23.2	23.2	23.2	23.0	23.2	22.9	23.2	23.1	23.0	23.1	
					Min	**20.7**	21.2	**21.0**	21.2	**20.6**	**21.0**	**20.9**	**20.8**	**20.8**	**20.6**	21.4	
Yangebup Lake	Staff 605 6142523	13.9–15.5 <16.5 peak	13.8	Either Bibra or Yangebup Lake must contain 0.3 m water, preferably 0.5 m	Max	16.1	16.0	16.6	16.6	15.9	15.9	15.9	17.1	16.9	16.4	16.8	Compliance: **Compliant with absolute minimum and other criteria.** Additional information: As part of the Jandakot Drainage Scheme, the Water Corporation monitors water levels at the site and lowers water levels if the peak is exceeded.
					Min	15.0	15.0	15.6	15.4	14.5	15.1	15.2	15.6	15.5	14.9	15.2	
	Bore JE21C 61419707				Max	15.6	15.9	15.9	16.1	15.3	15.3	15.3	16.2	16.2	15.8	16.0	
					Min	14.6	14.8	15.1	15.0	14.1	14.6	14.6	15.0	15.0	14.9	15.1	
Banganup Lake	Staff 5719 6142516	N/A	11.5	N/A	Max	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	Compliance and trends: **Non-compliant with absolute summer minimum criterion** 2014–15 was the first year groundwater levels at the lake have been compliant with the absolute minimum criteria since 2009–10. Water levels fell below this criterion in 2015–16 and 2016–17. Management and mitigation: In 2014–15, we updated the allocation limits in the Jandakot groundwater area based on a review that considered compliance, water level trends and ecological heath at the lake. The revised allocation limits reduce the risk of future increases in abstraction impacting on lake levels.
					Min	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	
	Bore LB14 61419614				Max	12.4	12.6	12.6	12.5	12.0	12.3	12.1	12.4	12.2	12.3	12.3	
					Min	11.5	11.7	11.5	11.6	**11.2**	**11.4**	**11.4**	**11.4**	11.6	**11.3**	**11.4**	
Twin Bartram Swamp	Staff JE7C 6142544	22.8	22.5	No drying before end of January. Must be above preferred minimum 4 in every 6 years.	Max	23.8	23.8	24.4	24.4	23.7	23.8	24.3	24.7	24.6	24.3	24.4	Compliance and trends: **Compliant with absolute minimum and other criteria.** In 2014–15, the peak surface water level was the second highest on record and the minimum level was the highest recorded since 2009–10. Levels remained relatively stable over the reporting period.
					Min	23.0 **dry 12/01**	23.0 **dry 09/01**	23.5	23.2	23.0 **dry 04/01**	23.1	23.2	23.4	23.5	23.3	23.7	
	Bore JE6C 61410715				Max	23.9	24.4	24.5	24.5	23.8	23.9	24.3	24.7	24.6	24.3	24.4	
					Min	23.0	23.1	23.5	23.4	22.7	23.1	23.3	23.4	23.6	23.3	23.7	

Wetland	AWRC reference number	Water level criteria (mAHD)		Other criteria	Water level (mAHD)											Comments on compliance during the 2014–17 reporting period
		Preferred	Absolute			2006–07	2007–08	2008–09	2009–10	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	
Shirley Balla Swamp	Staff 6142576	N/A	23.1 mAHD or 0.5 m below lake base, whichever is higher 24.5	No drying 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	25.1	25.0	25.0	25.0	25.1	25.1	25.0	25.2	25.5	25.3	25.2	Compliance and trends: **Compliant with absolute minimum criterion.** In 2015–16 and 2016–17 levels fell back below this criterion after being compliant in 2014–15. **Non-compliant with other criterion.** The swamp dries every year. Management and mitigation: In 2014–15, we updated the allocation limits in the Jandakot groundwater area based on a review that considered compliance, water level trends and ecological heath at the lake. The revised allocation limits reduce the risk of future increases in abstraction impacting on lake levels. Additional information: The EPA endorsed the 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.
					Min	**dry 27/09**	**dry**	**dry**	**dry**	**dry 01/09**	**dry 01/12**	**dry 05/11**	**dry 02/12**	**dry 02/02**	**dry 01/12**	**dry 01/12**	
	Bore 61410713				Max	24.9	25.0	25.4	25.3	24.6	24.6	25.1	25.3	25.6	25.4	25.2	
					Min	**24.0**	**24.3**	**24.2**	**24.2**	**23.8**	**24.3**	**24.1**	**24.4**	24.7	**24.2**	**24.2**	
Beenyup Road Swamp	Staff 6142547	24.0	23.6	Bore must be above preferred minimum 4 in every 6 years.	Max	24.6	24.7	25.1	25.1	24.7	25.1	25.1	25.3	25.3	24.9	25.1	Compliance: **Compliant with absolute minimum and other criteria.**
					Min	24.6 dry	24.6 dry	24.6 dry	24.6 dry	24.6 dry	24.6 dry	24.6 dry	24.6 dry	24.6 dry	24.6 dry	24.6 dry	
	Bore 61410711				Max	24.5	24.9	25.1	25.2	24.7	25.2	25.1	25.4	25.3	24.9	25.2	
					Min	23.8	24.1	24.2	24.2	23.9	24.3	24.3	24.4	24.4	24.1	24.5	

Table A2 Rare or phreatophytic flora sites

Monitoring bore	AWRC reference number	Water level criteria (mAHD)		Other criteria	Water level (mAHD)												Comments on compliance during the 2014–17 reporting period
		Preferred	Absolute			2006–07	2007–08	2008–09	2009–10	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	
Vegetation sites																	
JM14	61610247	24.39	23.89		Max	25.33	25.08	25.65	25.64	25.08	25.30	25.16	25.67	25.91	25.26	25.58	Compliance: **Compliant with absolute minimum criterion.**
					Min	24.05	24.39	24.63	24.64	**23.82**	24.59	24.34	24.61	24.78	24.35	24.68	
JM16	61610445	23.90	23.40		Max	25.02	25.19	25.51	25.50	24.95	25.27	24.94	25.53	25.56	25.13	25.30	Compliance: **Compliant with absolute minimum criterion.**
					Min	24.09	24.30	24.26	24.38	23.98	24.31	24.17	24.31	24.39	24.19	24.49	
JM19	61610177	25.26	24.76		Max	25.77	25.68	26.51	26.27	25.59	25.90	25.65	26.06	26.18	25.72	26.41	Compliance: **Compliant with absolute minimum criterion.**
					Min	**24.41**	24.90	25.16	25.26	**24.29**	25.12	24.86	24.90	25.26	24.84	25.28	
JM35	61610333	21.25	20.75		Max	25.43	25.64	25.95	25.82	24.33	25.68	25.44	25.76	26.06	25.02	23.39	Compliance: **Compliant with absolute minimum criterion.**
					Min	24.23	24.63	23.60	23.11	21.22	21.74	23.42	24.08	21.76	20.91	21.45	
JM39	61410142	21.20	20.70		Max	23.06	23.12	23.87	24.27	22.66	23.86	23.46	23.80	23.71	22.46	22.76	Compliance: **Compliant with absolute minimum criterion.**
					Min	21.30	21.56	21.56	21.62	21.16	21.86	21.88	21.52	21.37	20.76	21.08	
JM49	61410111	22.34	21.84		Max	23.71	23.76	23.80	23.81	23.49	23.86	23.73	23.89	23.98	23.67	23.86	Compliance: **Compliant with absolute minimum criterion.**
					Min	22.92	23.15	23.12	23.19	22.75	23.25	22.98	23.04	23.01	22.93	23.08	
8284	61610178	24.82	24.32		Max	25.60	25.80	25.80	25.70	25.35	25.62	25.38	25.79	25.99	25.68	25.78	Compliance: **Compliant with absolute minimum criterion.** Additional information: 8284 has recently been decommissioned as it collapsed while being airlifted. The department has used the recently installed 8284B (AWRC ref. 61611864) to measure water level criteria.
					Min	25.00	25.00	25.00	25.00	25.00	25.03	25.00	25.07	25.29	24.99	25.11	
JE4C	61610234	24.00	23.50		Max	25.19	25.18	25.85	25.70	24.83	25.63	23.85	25.81	25.95	25.45	25.72	Compliance: **Compliant with absolute minimum criterion.**
					Min	24.00	24.41	24.49	24.43	24.00	24.78	23.30	24.59	24.71	24.43	24.79	
JE10C	61410250	21.80	21.30		Max	25.21	25.39	25.79	25.98	24.86	25.28	25.06	25.72	25.98	26.04	25.48	Compliance: **Compliant with absolute minimum criterion.**
					Min	22.66	23.70	23.46	23.25	22.46	23.81	23.26	23.31	23.94	23.01	23.62	
Rare flora sites																	
JM7	61610180		22.06	< 0.1 m decline per year	Max	23.29	23.38	23.86	23.84	23.27	23.84	23.85	24.48	24.61	24.35	24.41	Compliance: **Compliant with absolute minimum criterion.**
					Min	22.52	22.82	22.90	22.97	22.30	23.13	23.06	23.59	23.77	23.56	23.81	
JM8	61610248		23.38	< 0.1 m decline per year	Max	24.63	24.57	25.00	25.12	24.49	24.88	24.66	25.29	25.58			Unavailable. Monitoring of water levels stopped in September 2014 due to access issues so we are unable to determine compliance with absolute summer minimum water level criteria.
					Min	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	23.88	23.57	24.12	24.12	23.62	23.91	23.85	24.45	24.76	24.39	24.59	Compliance: **Compliant with absolute minimum criterion.** Additional information: JM45 has recently been decommissioned due to development in the area. The department used the recently installed JM45A (AWRC ref. 61618756) to measure water level criteria in 2016–17.
					Min	23.03	23.17	23.38	23.38	22.71	23.45	23.30	23.72	23.97	23.69	23.82	
JE17C	61419703		16.35	< 0.1 m decline per year	Max	18.01	18.12	18.15	18.13	18.06	18.05	18.06	18.16	18.27	18.13	18.18	Compliance: **Compliant with absolute minimum criterion.**
					Min	17.37	17.46	17.53	17.68	16.97	17.48	17.36	17.55	17.39	17.45	17.76	

Appendix B — Audit tables: Environmental conditions, procedures and commitments for the Jandakot Mound

Proponent: Department of Water and Environmental Regulation

Period: 1 July 2014 to 30 June 2017

Blue text shows where the Department of Water and Environmnetal Regulation seeks advice from the Department of Parks and Wildlife (DPaW) and/or the Office of the Environmental Protection Authority (OEPA) on 'clearing' conditions and/or proponent commitments.

Note: *Ministerial statement no. 688* refers to the former Water and Rivers Commission's (now Department of Water's) responsibilities to the OEPA. In some cases, although referred to below as OEPA, some responsibilities now lie with DPaW.

Table B1 Ministerial conditions and procedures

Audit code	Subject	Action	How	Evidence	Require-ment of:	On advice from	Pha se	When/Where	Status for 2016–17
688: M 1-1	Implementation	The proponent shall implement the proposals as documented in *Section 46 Review of Environmental Conditions on Management of the Gnangara 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 *Ministerial statement no. 688*.	Compliance report.	Minister for the Environment		Ove rall		**Partly compliant.** Compliant with most Ministerial conditions – refer to the status column of this table.
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 *Ministerial 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 *Ministerial statement no. 688*.	Compliance report	Minister for the Environment	EPA	Ove rall		**Partly compliant.** Compliant with most proponent commitments – refer to the status column of this Appendix.
688: M 3-1	Proponent nomination & contact details	The proponent nominated by the Minister for the Environment under section 38 (6) or (7) of the *Environmental Protection Act 1986* 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 *Ministerial statement no. 688*.	Letter notifying the Chief Executive Officer of the OEPA of any change in proponent details.	Minister for the Environment	EPA	Ove rall		N/A at this time.
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		Ove rall		N/A at this time.
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		Ove rall	60 days of change	N/A at this time.

Audit code	Subject	Action	How	Evidence	Require-ment of:	On advice from	Phase	When/Where	Status for 2016–17
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	**The Department of Water seeks advice on 'clearing' this condition.** The 'status of implementation of the proposals' is 'completed' because Jandakot scheme stages 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	**The Department of Water seeks advice on 'clearing' this condition.** An audit program (see 688: P 14) was submitted to the EPA on 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	**Compliant.** Detailed in sections 6 and 7 of this report and status column of this Appendix.
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 *Environmental Protection Act 1986*, 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	**Compliant.** Detailed in sections 6 and 7 of this report and status column of this Appendix. Also refer to the results in Appendix A and Table 4 (Section 6).
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.	**Compliant.** Detailed in sections 6 and 7 of this report and status column of this Appendix. Also refer to the results in Appendix A and Table 4 (Section 6).
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.	**Compliant.** This report provides the required performance review and evidence of whether the environmental objectives (refer to Table 2 in the Appendix B for objectives) are being met.

Audit code	Subject	Action	How	Evidence	Require-ment of:	On advice from	Phase	When/Where	Status for 2016–17
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 in Ministerial statement 688: P 7, 9, 10, 11, 16, and 17.	Compliance report.	CEO		Overall	By 1 December each year and more detailed reports by 1 February every three years.	**Compliant.** Detailed in this report. The Jandakot Community Consultative Committee (JCCC) met in: • August 2014 • October 2015 • September 2016 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.	**Compliant.** 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 and Perth Regional Confined Aquifer Capacity project (see Section 6.3). The department used outcomes from environmental monitoring and hydrogeological investigations to review allocation limits for the Jandakot groundwater area and also uses these 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:	Reports made available on the Department of Water website: <www.water.wa.gov.au>	CEO		Overall	After OEPA acknowled-gement letter being received. Department of Water website.	**Compliant.** The following Jandakot compliance reports can be found on the department's website : • 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) • 2011–14 triennial (DoW 2014) • 2014–15 annual (DoW 2015b) • 2015–16 annual (DoW 2016c)
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 *Ministerial 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 compliances with water level and other criteria as required. Compliance report.	CEO		Overall	Immediately as it becomes evident.	**Compliant.** The department informs the OEPA of non-compliance with criteria water levels and other criteria in annual and triennial compliance reports.

Audit code	Subject	Action	How	Evidence	Require-ment of:	On advice from	Phase	When/Where	Status for 2016–17
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		**The Department of Water seeks advice on 'clearing' this condition.** The condition to implement the requirements set out in the Environmental Management Plan is met by following and meeting the commitments in *Ministerial statement no. 688*. The Environmental Management Plan was submitted to the former Department of Environment and Conservation 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 former Department of Environment, and now Department of Water, is demonstrating its implementation through the annual/triennial compliance reports to the OEPA. Implementation is reported as: • compliance with water level and other criteria • predictions of non-compliance with water level criteria • reporting on proponent and Ministerial conditions/commitments (audit tables) • implementation of the environmental monitoring program (required under other conditions).
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. Detailed in annual/triennial reports.	Reports made available on the Department of Water website: <www.water.wa.gov.au>	Minister for the Environment		Overall		**Compliant.** Changes to allocations, abstraction limits and licensing is 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		**Compliant.** Section 6 outlines the management actions the department is taking 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 *Operational policy no. 1.2 – Policy on water conservation/efficiency plans* (DoW 2009c). The department's Water Recycling and Efficiency staff undertake projects to reduce water demand and achieve water conservation initiatives (see Section 6.2.3). This includes implementing the above policy and 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		**No action required by the Department of Water.**
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		**No action required by the Department of Water.**
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		**Compliant.**

Table B2 The proponent's (Department of Water's) environmental management conditions

Audit code	Subject	Objective	Action	How	Evidence	Require-ment 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 (*Ministerial statement no. 688*).	Meet objectives and Environmental Water Provisions criteria presented in Tables 1 and 2 (*Ministerial statement no. 688*).	Compliance report	Minister for the Environment		Overall	**Partly compliant.** Detailed in section 6 and in Appendix A of this report.
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	**Compliant.** The department annually predicts whether sites are likely to be non-compliant with water level criteria during the coming summer and reviews public water supply abstraction to limit impacts at potentially non-compliant 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	**Partly compliant.** Water levels at a number of Ministerial sites (including North Lake and Bibra Lake) are consistently non-compliant with water level and other criteria. The department considered non-compliance and ecological condition at these sites in its review of allocation limits for the Jandakot and Cockburn groundwater areas. The department also considers non-compliance at these sites 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	**Compliant.** 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	**Compliant.** The department's recent management focus was refining the allocation limits in the Jandakot and Cockburn groundwater areas (see Section 6.2.2 and 6.2.3). This work considered licensed entitlements 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			**Compliant.** The department's recent management focus was refining the allocation limits in the Jandakot and Cockburn groundwater areas (see Section 6.2.2 and 6.2.3).
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 allocation work program.	Compliance report	EPA			**Compliant.** The department's recent management focus was refining the allocation limits in the Jandakot and Cockburn groundwater areas (see Section 6.2.2 and 6.2.3). This work used contemporary methods for determining sustainable limits for use in the decision-making process for the new allocation limits.

Audit code	Subject	Objective	Action	How	Evidence	Require-ment of	On advice from	When/ Where	Status
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			**N/A at this time.**
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			**Compliant.** 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 helped develop *Better urban water management* (WAPC 2008), a framework for land use planning assessments. The department also produced the *Jandakot drainage and water management plan* (DoW 2009d), which aims to assist land developers and local government to better manage groundwater quantity and quality in the area. The department recently provided advice on the *Southern Metropolitan and Peel sub-regional structure plan – Regional water management strategy,* which identifies water related constraints and opportunities associated with proposed urban and industrial areas. The department is working with other state agencies to provide advice into the Strategic Assessment of the Perth and Peel regions.
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			**Compliant.** See the status of 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			**Compliant.** The department produced the *Jandakot drainage and water management plan* (DoW 2009d), which aims to assist land developers and local government to better manage groundwater quantity and quality in the area. With the Department of Planning (and other agencies) the department has produced the *Better urban water management* publication (WAPC 2008). The department recently provided advice on the *Southern Metropolitan and Peel sub-regional structure plan – Regional water management strategy,* which identifies water related constraints and opportunities associated with proposed urban and industrial areas. The department is working with other state agencies to provide advice into the Strategic Assessment of the Perth and Peel regions.
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			**Compliant.** Section 6.2 outlines the actions the department is taking to manage supply and demand 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			**Compliant.** The department liaises with other water and land-use agencies to integrate management of the Jandakot catchment, including the Water Corporation, OEPA and the Western Australian Planning Commission. For example, the department prepared the *Jandakot drainage and water management plan* for the WAPC Jandakot structure plan area (see 688: P 9) with some modelling assistance from the Water Corporation.

Audit code	Subject	Objective	Action	How	Evidence	Require-ment of	On advice from	When/ Where	Status
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		**Compliant.** *Stage I Section 46* (DoE 2005) is complete and a number of changes were supported by the OEPA (refer Bulletin 1155). Stage II Section 46 work has concentrated on the Gnangara Mound area due to priorities (refer 2007–08 Gnangara compliance report, December 2008). The department's recent management focus was refining the allocation limits in the Jandakot and Cockburn groundwater areas (see Section 6.2.2 and 6.2.3).
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, Kogalup, 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			**Compliant.** Detailed in this 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 wetland and terrestrial vegetation sites are available on the department's website.
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: • monitoring of groundwater levels in all relevant aquifer systems • relevant wetland water levels and water quality • condition of vegetation and fauna associated with groundwater-dependent ecosystems.	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	**Compliant.** The department's monitoring program includes: • monitoring of groundwater levels in all relevant aquifer systems • relevant wetland water levels and water quality • condition of vegetation and fauna associated with groundwater-dependent ecosystems. The previous environmental monitoring program was submitted to the EPA on 21 December 2005. It was detailed in Appendix 7 of the Gnangara triennial report for 2003–06 (DoW 2007c). The EPA's audit of the 2006–07 compliance report agreed that the commitment could be 'cleared' upon confirmation from the DEC. The department reviewed the environmental monitoring program in June 2009 with the ecologists that do the monitoring (see Appendix D). A number of amendments were made. A letter was sent to the Director General of the DEC in December 2009, seeking advice and input on the amendments. The department may request further revisions after considering 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		**Compliant.** A summary of the results of the environmental monitoring over the reporting period (2014–17) is reported in Section 6.1. The department used these results to distribute public supply abstraction to limit environmental impacts and inform licensing decisions for private use. The department has also considered the results in its review of allocation limits in the Jandakot and Cockburn groundwater areas.
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 (coincides with triennial report)	**Compliant.** The department reviewed the environmental monitoring program in June 2009 with the ecologists that do the monitoring (see Appendix D). A number of amendments were made. A letter was sent to the Director General of the DEC in December 2009, seeking advice and input on the amendments. The department may request further revisions after considering recommendations from the Perth shallow groundwater systems investigations and the eco-hydrological states investigation (see Section 6.3).

Audit code	Subject	Objective	Action	How	Evidence	Require-ment of	On advice from	When/ Where	Status
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, Kogalup, 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 (coincides with triennial report)	**Partly-compliant.** There may be limited value using aerial photos solely as a diagnostic tool. This was recognised and the commitment was modified in Bulletin 1155. The department does 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 the 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			**Compliant.** Detailed in this report. The Jandakot Community Consultative Committee (JCCC) met in: • August 2014 • October 2015 • September 2016 and discussed the environmental management of abstraction from the Jandakot groundwater system.
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			**Compliant.** The department subscribes to the 'Media Portal' service provided by Isentia, which forwards water related newspaper articles to department employees so they are kept informed. 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			**Compliant.** The department installed groundwater monitoring bores 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 done at existing bores (see Section 6.3). The department is evaluating monitoring data at these wetlands to determine the groundwater–wetland water level relationship.
688: P 19	Environmental management and monitoring	Enable good water resource management including environmental protection on the Jandakot Mound.	1. Prepare a Management and Monitoring Program. 2. Implement the Management and Monitoring Program.	Prepare Management and Monitoring Program and submit to EPA.		EPA		Completed	**Completed.** **The Department of Water seeks advice on 'clearing' this condition.** This commitment was required prior to commissioning the Stage 2 scheme. Stage 2 was in operation for over 10 years and the implementation of the management and monitoring program is described in numerous annual and triennial compliance reports. In addition, following publication of *Ministerial statement no. 688*, a revised monitoring program was developed and submitted to EPA (refer Commitment 688: P 14) in December 2005.
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	**Completed.** **The Department of Water seeks advice on 'clearing' this condition.** Auditor's comments in the 2003–04 annual report state that the commitment can be 'cleared'. Research projects given in Appendix C (Table A12.2) of EPA *Bulletin 587* refer to commitments given in numbers 21, 22, and 23 below.

Audit code	Subject	Objective	Action	How	Evidence	Require-ment of	On advice from	When/ Where	Status
688: P 21		Improve understanding of aquatic fauna of the select Jandakot wetlands.	Develop a fauna monitoring program which will focus on: 1. waterbird species diversity and breeding success 2. the number of families of aquatic invertebrate and, at infrequent intervals, species richness.	Develop a fauna monitoring program.		EPA	CALM	Completed	**Completed.** **The Department of Water seeks advice on 'clearing' this condition.** Auditor's comments in the 2003–04 annual report agreed such a program had been developed and implemented prior to commissioning the Stage 2 scheme and that the commitment can be 'cleared'. A fauna monitoring program was developed and implemented. The results are presented in numerous annual and triennial reports to date.
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	**Completed.** **The Department of Water seeks advice on 'clearing' this condition.** The study was completed and Auditor comments in 2003–04 annual report states that Commitment can be 'cleared'.
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	**Completed.** **The Department of Water seeks advice on 'clearing' this condition.** The study was completed and Auditor's comments in 2003–04 annual report state that the commitment can be 'cleared'.

Appendix C — History of Ministerial statements for the Jandakot Mound

In 1988, the former 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 completed a Public Environmental Review (PER) level of assessment of 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. Most of the conditions and commitments related 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 that it confirmed environmental water provisions to maintain 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.

In 2001, as a consequence of changes in land use and lower rainfall, the EPA endorsed a two-stage approach to review the Ministerial conditions and commitments for the Gnangara and Jandakot mounds under section 46 of the *Environmental Protection Act 1986*. The first stage of the section 46 review was for the department (then the Department of Environment) to review Ministerial conditions and commitments on Gnangara and Jandakot based on existing knowledge (DoE 2005). This review led to *Ministerial statement no. 687* for Gnangara (Government of Western Australia 2005b) and *Ministerial statement no. 688* for Jandakot (Government of Western Australia 2005a).

The department further reviewed Ministerial conditions and commitments on Gnangara 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, which recommended changes to the Minister for Environment. *Ministerial statement no.819* for Gnangara (Government of Western Australia 2009) was released later that year including the consolidated and refined conditions and commitments.

The second stage of the section 46 review was proposed as a more comprehensive review to improve how we manage public and private abstraction and to incorporate ecological information using the results of work underway at the time. This stage was later improved by more recent investigations into the shallow groundwater systems and ecological responses to climate.

For Gnangara, the intent of the second stage review will be covered by the next phase of planning for Gnangara groundwater resources. For Jandakot, we will use the analysis of recent work to focus our management efforts in the areas that will most benefit from changes to abstraction.

Appendix D — Review of the environmental monitoring program (688: P 14 1)

In mid-2009, the department started a series of workshops to review the current environmental monitoring with the ecologists contracted to do the work. The workshops aimed to improve both the effectiveness and efficiency of the environmental monitoring program.

Our initial review of the environmental monitoring program:

- refocused the program on the relationships between groundwater levels, ecological condition, and abstraction
- improved efficiency 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.

In a second review workshop, held in late April 2010, we considered two key issues:

- how monitoring results could be presented spatially so that it represents 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.

There were three main outcomes and recommendations from this second workshop:

- Future monitoring programs should include sites where ecological health and compliance can be improved 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 workshop 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: J:\gisprojects\Project\C_series\C2207\0004\141118

Filename: C2207

Compilation date: November 2014

Disclaimer

This map is a product of the Department of Water and Environmental Regulation and was printed on November 2014.

While the Department of Water and Environmental Regulation 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 and Environmental Regulation acknowledges the following datasets and their custodians in the production of this map:

Western Australia Towns – DLI – 12/07/2001

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

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

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