

State of the catchments 2010

Groundwater

Western region

State Plan target

By 2015, there is an improvement in the ability of groundwater systems to support groundwater dependent ecosystems and designated beneficial uses.

The intent of the target as defined by the Natural Resources Commission (NRC) is to 'ensure that groundwater continues to support ecosystem function, human health and economic activity'.

Background

The target is broad-ranging in terms of the values that it is attempting to improve. The three key areas addressed by the target are outlined below:

Ecosystem function

Ecosystems that are fully or partially reliant on groundwater to maintain ecosystem function are known as groundwater dependent ecosystems (GDEs). These occur across both surface and subsurface landscapes and are highly variable. GDEs have their species composition and natural ecological processes determined by groundwater (ARMCANZ & ANZECC 1996).

A detailed technical report describes the methods used to derive the information contained in this report. At the time of publication of the *State of the catchments (SOC) 2010* reports, the technical reports were being prepared for public release. When complete, they will be available on the NOW website: www.water.nsw.gov.au.

Note: All data on natural resource condition, pressures and management activity included in this SOC report, as well as the technical report, was collected up to January 2009.

GDEs are classified into six broad types:

- karst and caves
- groundwater dependent wetlands
- aquifers
- base flow rivers and streams
- terrestrial vegetation
- estuarine and near-shore marine ecosystems.

Human health

This element of the target refers to the maintenance of beneficial uses of groundwater by preventing deterioration in groundwater quality or contamination by the pollutants. Groundwater pollution can take many forms, ranging from saltwater intrusion and release of such matrix elements as iron and arsenic from over-extraction, to contamination from pollution events (eg chemical spills, leakages, or contaminated runoff into poorly constructed bores).

Economic activity

Maintenance of a range of beneficial uses (as defined by the NRC) is achieved by keeping groundwater extraction at sustainable levels. This provides a level of security of supply and decreases the risk of contamination and ecological harm occurring from over-extraction.

Within the Western region there are alluvial, fractured rock and porous rock aquifer province groundwater management areas (GWMAs). Table 1 identifies the GWMAs in the region. The location of the GWMAs is shown in Figure 1.

Table 1 GWMAs in the Western region

Alluvial GWMAs	Fractured rock GWMAs	Porous rock GWMAs
Upper Darling Alluvium	Adelaide Fold Belt	Western Murray
Lower Lachlan Alluvium	Kanmantoo Fold Belt	Great Artesian Basin
Great Artesian Basin Alluvial	Lachlan Fold Belt	
Lower Darling Alluvium		

The highest yielding and most actively used bores in the region are located in the Great Artesian Basin (GAB). The bores are used for stock and domestic purposes as well as irrigation. The high yielding area of the Lower Lachlan Alluvium occurs in the Lachlan region adjoining the Western region. The area within the Western region is not actively used due to the groundwater salinity and lower yields. The other GWMAs generally yield volumes not appropriate for irrigation or contain groundwater that is too saline.

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) has completed an assessment of the sustainability of the surface and groundwater systems at a catchment scale as part of the Murray–Darling Basin Sustainable Yields Project. The assessment was based on 18 regions representing the major tributaries of the Murray–Darling Basin including the Barwon–

Darling, Murray, Macquarie–Bogan, Paroo, Warrego, and Condamine–Balonne regions. The reports can be viewed at www.csiro.au/partnerships/MDBSY.html.

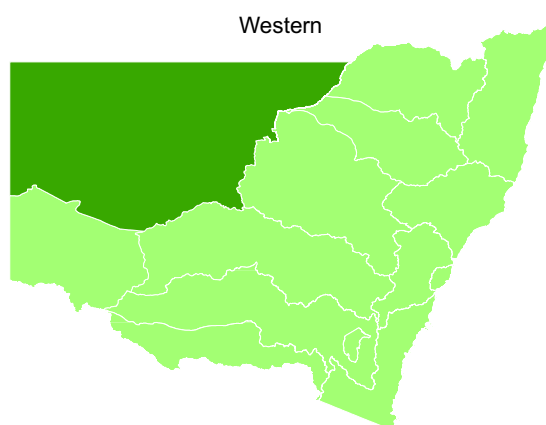
The alluvial aquifer system associated with the Upper Darling consists of freshwater lenses supplied and maintained by the Darling River. There are regions of the alluvial aquifer system that contribute saline water into the Darling River. At a location known as 'Glen Villa', a proposed salt interception scheme (SIS) is under investigation. The SIS will reduce the contribution of saline groundwater to the Darling River and reduce the salinity in the River Murray at Morgan. More information on the investigation at the 'Glen Villa' site (Williams 1994, Williams & d'Hautefeuille 2003) is recorded in the 'Further reading' section of this report.

The Great Artesian Basin (GAB) GWMA is the largest aquifer system in the region and most well known in Australia. The GAB is a porous rock aquifer system, hundreds of metres in thickness. It underlies south-western Queensland, north-western NSW and northern South Australia.

In the Western region, the GAB is artesian with the water free flowing at the surface. The GAB has been experiencing a decline in groundwater pressure associated with many free flowing bores (GABCC 1998). The NSW Cap and Pipe the Bores Program is ensuring that these free flowing bores are rehabilitated and capped, with water piped for domestic and stock purposes.

There are a number of mound springs that are fed by water from the GAB. The decline in groundwater pressure from the GAB is impacting on the condition of the mound springs (Brownbill 2000).

Map of the catchment



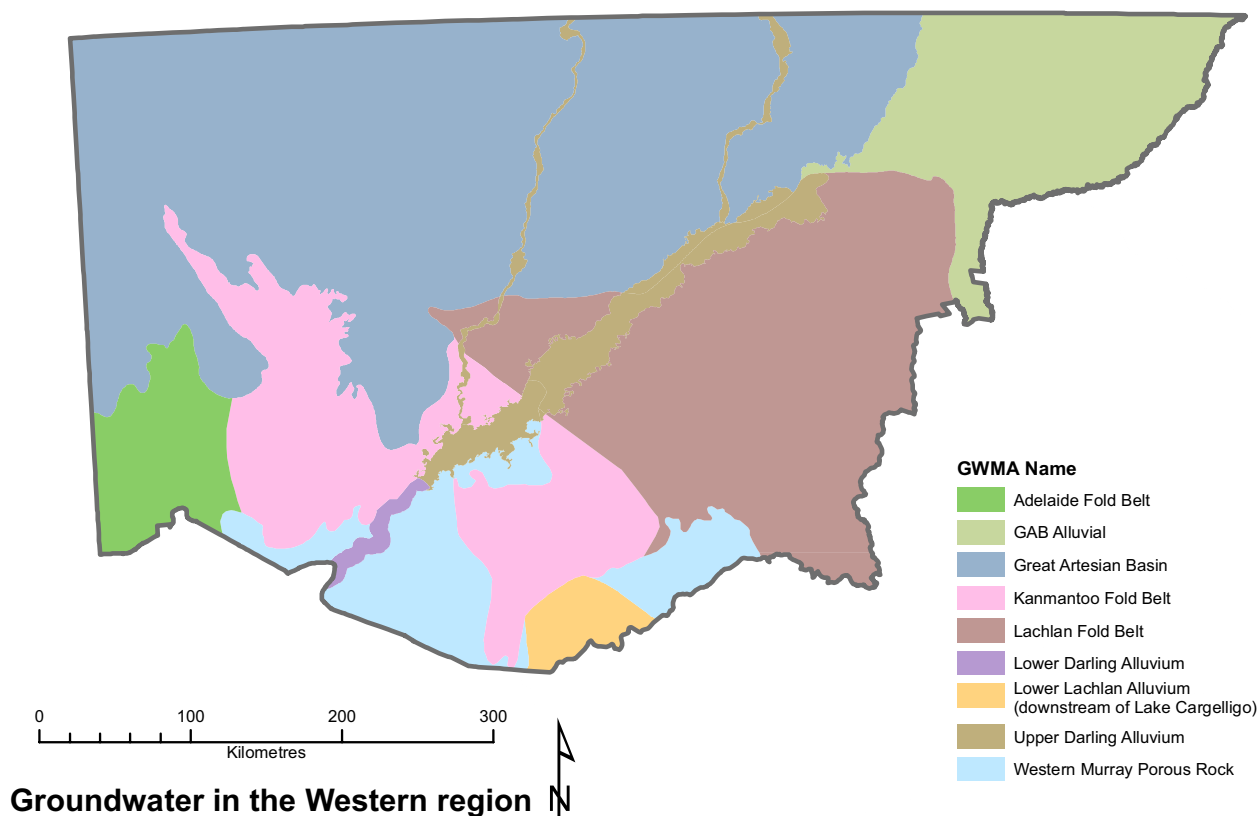


Figure 1 Western region groundwater management areas

Assessment

The assessment of condition and pressure for the groundwater aquifers in the region has been based on the GWMA. The assessment focuses on the whole of each GWMA, including the areas extending beyond the Western region.

In the Western region, groundwater pressures in the GAB are measured to monitor changes from the use of the resource and the Cap and Pipe the Bores Program.

The assessment of condition and pressure relative to the target has been based on both available information and expert opinion within the NSW Government. Seven indicators were used to assess both condition and pressure. Of those seven indicators, one was quantifiable for both condition and pressure using available information. The long-term annual average extraction limit (LTAAEL) is the proportion of the long-term average annual recharge of water to the groundwater system available for extraction. The condition indicator quantified is the ratio of the amount of groundwater actually extracted and used in a given year compared with the LTAAEL. The pressure indicator quantified is the ratio of the total annual entitlements for extraction held by licence holders compared with the LTAAEL. Low ratios for these indicators would result in a ranking of 'very good' for condition and 'very low' for pressure.

The other six indicators used for assessing condition and pressure were determined using expert opinion, as current monitoring of aquifer systems in NSW does not provide sufficient data for more comprehensive analysis.

Condition

In addition to the quantifiable indicator of extraction vs LTAAEL, the six other indicators of condition used to assess each groundwater source within the Western region are described in Table 2.

Table 2 Description of condition indicators

Indicator	Description
Extraction vs LTAAEL	The total annual usage compared with the LTAAEL available for extraction
GDE condition	The condition of GDEs in the region, in terms of their access to the amount and quality of groundwater they require
Landscape condition	The condition of the wider landscape in terms of potential changes caused by land-use to groundwater quality and the volume of water available for recharging the aquifer: increased recharge causes groundwater levels to rise, which can have an impact on the productivity of agriculture and the condition of urban infrastructure. Taken together, these measures can be used to make an assessment of landscape condition
Regional groundwater levels	Change in regional groundwater levels from the influence of extraction: where groundwater levels are not monitored, changes in the duration of pumping time that groundwater is available for basic landholder access and other licensed users can be used as a surrogate
Local groundwater levels	Change in local groundwater levels from the influence of extraction
Groundwater quality	Groundwater quality, as measured by the following: <ul style="list-style-type: none"> • groundwater acidity • groundwater salinity • nutrient concentrations • contamination from heavy metals and hydrocarbons • changes in beneficial use category (resulting from groundwater quality changes) • freshwater/saltwater interface (indicated by electrical conductivity)
Aquifer integrity	The integrity of the aquifer matrix, which can be affected by dewatering and compaction with consequent ground subsidence or upsidence, or by various land-use activities

The GWMA in the Western region are generally in good to very good condition (see Table 3). GDE condition is ranked very poor for the GAB GWMA. This is due to free-flowing bores reducing the groundwater pressure. This has reduced the availability of groundwater to mound springs and other GDEs in the region. The implementation of the NSW Cap and Pipe the Bores Program should see an improvement over time in groundwater pressure in the GAB and ensure the availability of water for the affected GDEs.







The level of groundwater use in the region is shown in Figure 2. The Murray–Darling Basin Sustainable Yields Project (CSIRO 2008) identifies the impact of climate change and water use on the relationship between the surface and groundwater systems in the region (www.csiro.au/partnerships/MDBSY.html).

There is limited information on the condition of GDEs in the Western region, except for the mound springs in the GAB. Research and a number of projects are monitoring these ecosystems throughout the GAB. A desktop assessment by the former Department of Water and Energy (DWE 2008) identified high priority GDEs in the region, as shown in Figure 3. The desktop assessment methodology does not currently include terrestrial ecosystems.

There are significant knowledge gaps in relation to groundwater quality and the location and condition of GDEs, especially terrestrial, wetland and base flow GDEs. At a regional scale, the level of groundwater use in the catchment is unlikely to affect the condition of GDEs. However, there may be localised areas where groundwater use is causing impacts on terrestrial or other GDEs, such as in the GAB.

Table 3 Groundwater source condition summary

	GDE Condition	Data Confidence	Trend	Landscape Condition	Data Confidence	Trend	Regional Groundwater Levels	Data Confidence	Trend	Local Groundwater Levels	Data Confidence	Trend	Groundwater Quality	Data Confidence	Trend	Aquifer Integrity	Data Confidence	Trend	Percentage Use to the LTAAEL	Data Confidence	Trend	GWMA Condition Index
GWMA no. and name																						
046 Upper Darling Alluvium		H ?			H ?			H ?			H ?			M ?			M ?			H ?		
045 Lower Darling Alluvium		L ?			M ?			H ?			M ?			M ?			H ?			M ?		
063 GAB Alluvial					M ?			L ?			M ?			L ?			M ?					
601 Great Artesian Basin					M ?			H ?			M ?			M ?			H ?					
612 Western Murray Porous Rock		M ?						L ?			M ?			L ?			H ?					
811 Lachlan Fold Belt - Darling Catchment		L ?			M ?			H ?			M ?			L ?			H ?			M ?		
817 Kanmantoo Fold Belt					M ?			H ?			M ?			L ?			H ?					
818 Adelaide Fold Belt					M ?			H ?			M ?			L ?			H ?					

Condition	Trend	Data confidence
 Very good	↑ Improving	H High
 Good	↔ No change	M Medium
 Fair	↓ Declining	L Low
 Poor	?	Unknown
 Very poor		
 No data		

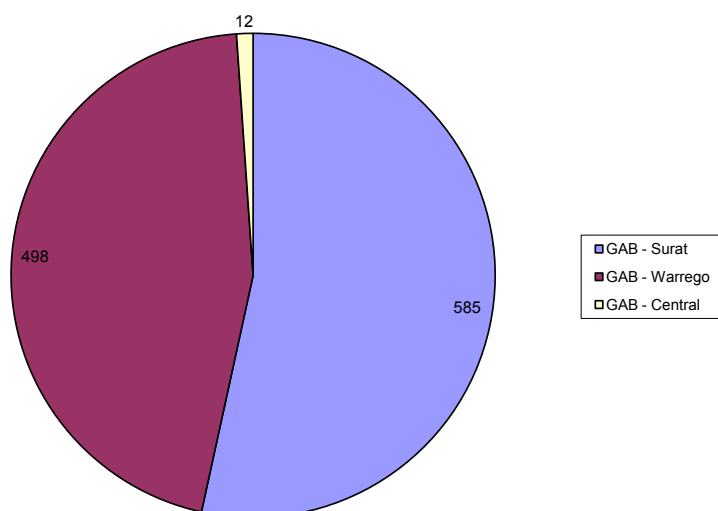


Figure 2 2007–08 metered groundwater use in the Western region (megalitres)

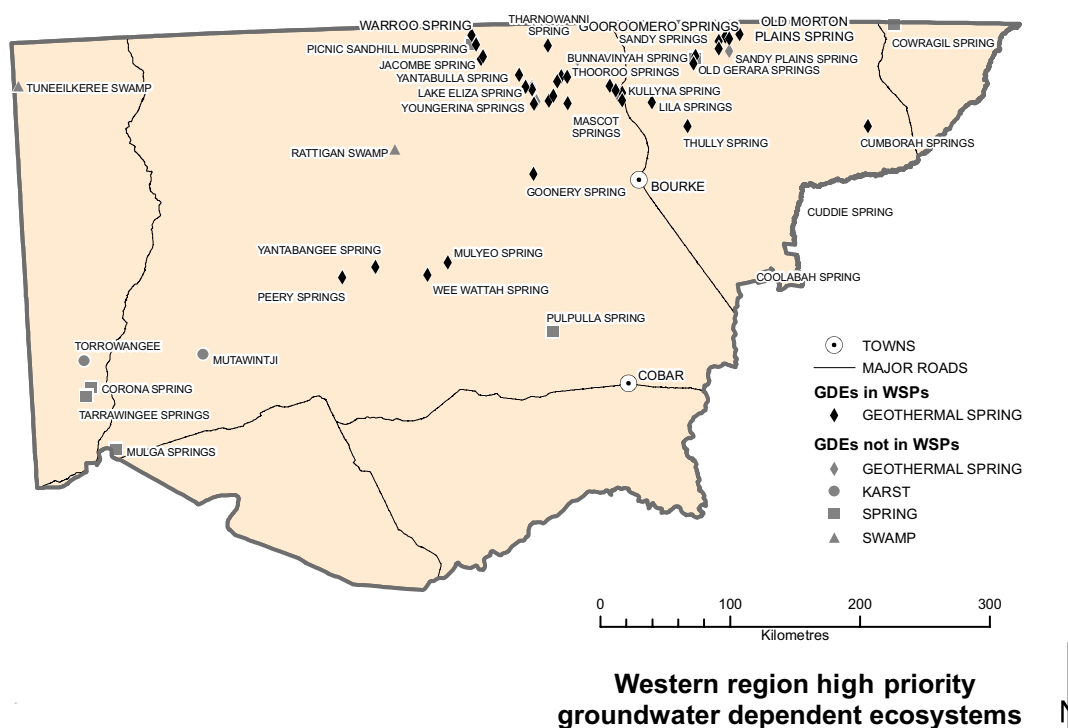


Figure 3 High priority and water sharing plan (WSP) identified GDEs

Pressures

'Pressures' in this report refers to the potential impacts of human activity on the groundwater system. (NB: This is different from the 'pressure' term as used in the discipline of hydrogeology.)

In addition to the quantifiable indicator of entitlements vs LTAAEL, the six other indicators of pressure used to assess each groundwater source within the Western region are described in Table 4.

Table 4 Description of pressure indicator

Indicator	Description
Entitlements vs LTAAEL	The total annual entitlements compared with the LTAAEL available for extraction
GDE groundwater availability	The pressure on GDEs from long-term and seasonal changes in groundwater levels, including the influence of changes in groundwater levels in highly connected systems
Land-use pressures	The pressure of land-use on aquifer systems: The indicator also identifies the pressure that shallow groundwater levels place on productive land or urban areas (eg the creation of salinity issues), and combines both these measures into a single indicator
Regional impacts	The extent to which current groundwater extraction could potentially affect regional groundwater levels
Localised impacts	The extent to which current groundwater extraction could potentially affect localised groundwater levels
Groundwater quality impacts	Potential contamination of groundwater from: <ul style="list-style-type: none"> • various discrete or dispersed sources • migration of water of a lower quality • acidification from exposure of acid sulfate soils through the lowering of groundwater levels • changes to seawater and groundwater interfaces from extraction in coastal sand aquifers
Aquifer structure pressures	The effect on groundwater flow systems from compaction, or changes to aquifer material through groundwater extraction and from the removal of aquifers in mining or quarrying activities







The GWMA in the Western region are generally under low or very low pressure (see Table 5). There is generally a fair to very poor ranking for GDE groundwater availability and land-use pressures. This is due to the free-flowing bores in the GAB reducing the groundwater pressure and the availability of water for land-use.

Groundwater resources in the catchment are generally not overused. The highest use is in the GAB. The level of groundwater use in the catchment is shown in Figure 2.

Because of the limited knowledge on the location of GDEs within the catchment, especially terrestrial ecosystems, further research is required to more fully assess pressures on aquifers in the Western region.

Table 5 Groundwater source pressure summary

GWMA no. and name	GDE Groundwater Availability		Data Confidence		Trend		Land-use Pressures		Data Confidence		Trend		Regional Impacts		Data Confidence		Trend		Localised Impacts		Data Confidence		Trend		Groundwater Quality Impacts		Data Confidence		Trend		Aquifer Structure Pressures		Data Confidence		Trend		Entitlement/Share Component to the LTAAEL		Data Confidence		Trend		GWMA Pressure Index	
046 Upper Darling Alluvial			M	?					M	↓				M	↔						H	↔					L	?					H	?			H	↔						
045 Lower Darling Alluvial			L	?					M	↓				M	↔						M	↔					L	?					H	?			H	↔						
063 GAB Alluvial									M	↓				H	↔						M	↔					L	?					H	?			H	↔						
601 Great Artesian Basin			L	↑					M	↔				L	↔						M	↔					M	?					H	?			H	↔						
612 Western Murray Porous Rock			L	?					H	↓				M	↔						H	↔					L	?					H	?			H	↔						
811 Lachlan Fold Belt - Darling Catchment									H	↔				M	↔						H	↔					L	?					H	?			H	↔						
817 Kanmantoo Fold Belt									H	↔				H	↔						H	↔					L	?					H	?			H	↔						
818 Adelaide Fold Belt									H	↔				M	↔						H	↔					L	?					H	?			H	↔						

Pressure	
	Very low
	Low
	Moderate
	High
	Very high
	No data

Trend	
↑	Increasing
↔	No change
↓	Decreasing
?	Unknown

Data confidence	
H	High
M	Medium
L	Low

Management activity

Regional initiatives

The State Plan natural resource management targets are being addressed through state, regional and local partnerships. The catchment action plans (CAPs) and the investment programs that support the CAPs are the key documents that coordinate targeted projects for the improvement of natural resources across NSW. The CAPs describe the whole-of-Government approach, and specify regional targets and activities that contribute to the achievement of the state-wide targets. The Western CAP can be found at www.western.cma.nsw.gov.au/Pages/Tenyearcatchmentplan.html.

Land-use planning in the region is primarily achieved through local environmental plans (LEPs). All LEPs in the state are currently being reviewed by local governments in consultation with NSW Government agencies and the local community. The plans aim to ensure that appropriate development occurs in the landscape with consideration of future population demands, economic issues and the protection of natural resources and environmental assets in the area. LEPs are statutory controls against which development proposals are assessed. With respect to groundwater, LEPs ensure that development is prevented or restricted in locations where there is a high likelihood of groundwater contamination or the potential for development to increase salinity.

within the landscape.

Groundwater use and entitlement

The groundwater target is being addressed at the state level through WSPs for groundwater sources where there is over-allocation of entitlements or a need to protect high value ecosystems. The implementation of WSPs, which are plans to ensure the equitable and sustainable sharing of water, will ensure long-term water management for GDEs and other beneficial uses. However, some groundwater systems in NSW will remain under stress until current processes to reduce use to sustainable levels are complete. Key initiatives to meet this challenge include:

- managing the NSW Cap and Pipe the Bores Program in accordance with the National Great Artesian Basin Initiative
- continuing the implementation of current WSPs
- completing the remaining WSPs in the Murray–Darling Basin by 2011 and elsewhere before 2013
- expanding the existing groundwater level monitoring network through capital funding by the NSW Government
- adjusting future WSPs where necessary to account for climate change impacts
- effectively implementing the monitoring, evaluation and reporting strategy.

There are a number of activities being implemented to better understand groundwater systems, including:

- funding provided to the NSW Cap and Pipe the Bores Program by the Western CMA to support individual Bore Trusts implement infrastructure works
- a program established by the Western CMA to help landholders redevelop property management plans following their involvement in the NSW Cap and Pipe the Bores Program
- several extension activities to inform the community of issues regarding the Great Artesian Basin (GAB), such as the production of an informative DVD on the GAB
- the expansion of the existing groundwater level monitoring network
- the implementation of telemetered time series groundwater level monitoring sites in the inland alluvial water sharing plan areas.

Groundwater dependent ecosystems

There are a number of activities being implemented around NSW to better understand GDEs, including:

- a trial remote sensing project to identify terrestrial GDEs in the Lower Macquarie GWMA
- staged spatial mapping of potential GDEs across NSW
- an impact study on mound springs in the region, undertaken by a PhD student with funding from the Western CMA, leading to development of plans to manage high priority mound springs.

Further reading

ARMCANZ & ANZECC 1996, *National Principles for the Provision of Water for Ecosystems*, Occasional Paper SWR No 3, Sustainable Land and Water Resource Management Committee, Subcommittee on Water Resources, Canberra.

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