

State of the catchments 2010

Groundwater

Lachlan 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 the 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 Lachlan region there are alluvial and fractured rock aquifer province groundwater management areas (GWMAs). Table 1 identifies the GWMAs in the region. The locations of the GWMAs are shown in Figure 1.

Table 1 GWMAs in the Lachlan region

Alluvial GWMAs	Fractured rock GWMAs
Belubula Valley Alluvium	Lachlan Fold Belt
Lower Lachlan Alluvium	Orange Basalt
Lower Murrumbidgee Deep Alluvium	Young Granite
Lower Murrumbidgee Shallow Alluvium	
Upper Lachlan Alluvium Zone 1	
Upper Lachlan Alluvium Zone 2	
Upper Lachlan Alluvium Zone 3	
Upper Lachlan Alluvium Zone 4	
Upper Lachlan Alluvium Zone 5	

Upper Lachlan Alluvium Zone 6

Upper Lachlan Alluvium Zone 7

Upper Lachlan Alluvium Zone 8

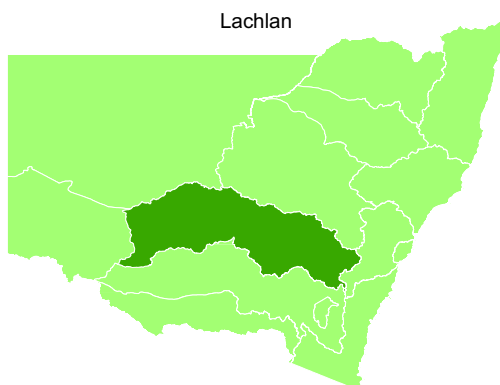
The highest yielding and most actively used bores in the Lachlan region are located in the alluvial aquifers. The Lower Lachlan GWMA has a water management plan, which commenced in February 2008. The level of entitlement prior to the commencement of the plan exceeded the long-term annual average extraction limit (LTAAEL). This is the proportion of the long-term average annual recharge of water to the groundwater system available for extraction. The plan reduces the level of water entitlement over ten years to the LTAAEL. Licence holders have also received structural adjustment through the Achieving Sustainable Groundwater Entitlements (ASGE) scheme to alter their enterprises to the reduced level of entitlement.

The Upper Lachlan Alluvium, Belubula Valley Alluvium, Young Granite and Orange Basalt GWMAs are also areas of high groundwater use and entitlement. The Upper Lachlan Alluvium and Belubula Valley Alluvium GWMAs are high yielding aquifers. In these GWMAs the water is mainly used for the irrigation of large areas, such as crops and pasture, whereas in the Young Granite and Orange Basalt GWMAs the groundwater is used for the irrigation of cherries and apples respectively.

The Lachlan Fold Belt GWMA has diverse characteristics due to the large area it covers. In the upper catchment it contributes flows to streams and is the source of spring flows. These systems support a diverse range of aquatic and terrestrial ecosystems, either directly or indirectly. They also ensure the availability of stock and domestic water for landholders.

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 Lachlan region. This report can be viewed at www.csiro.au/partnerships/MDBSY.html.

Map of the catchment



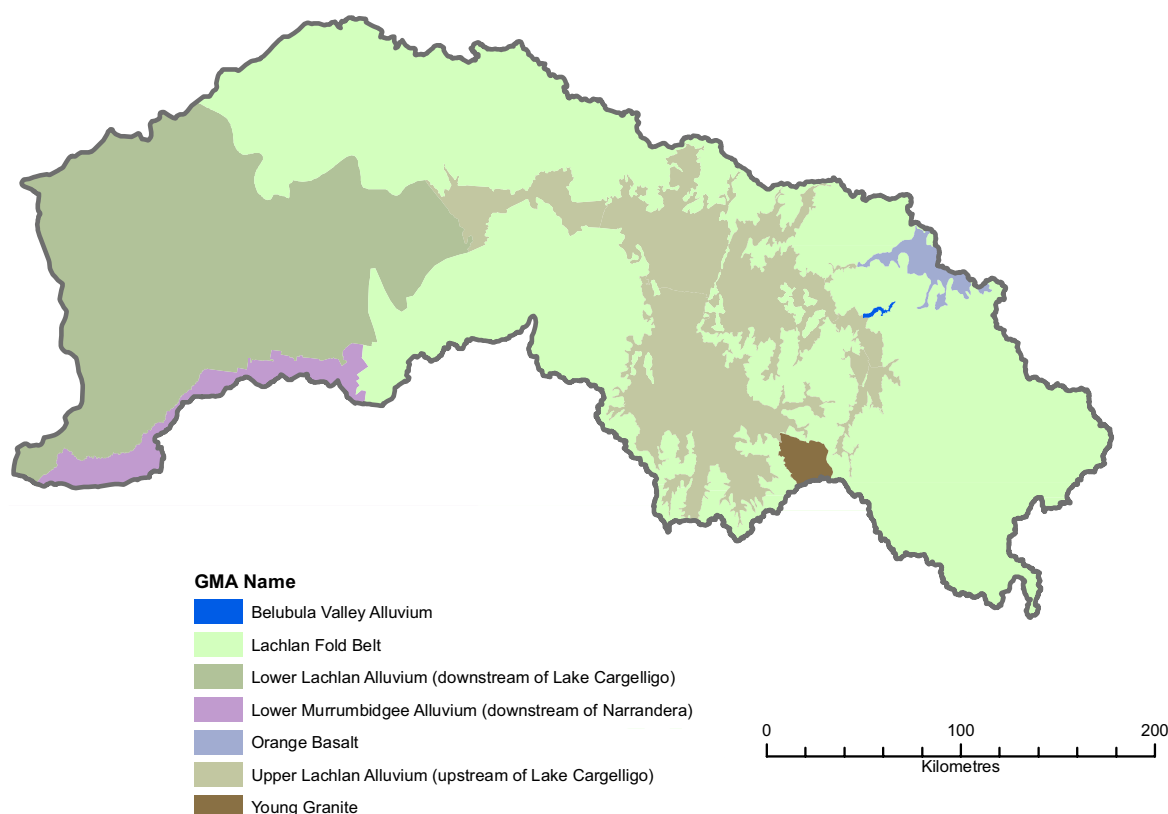


Figure 1 Lachlan region groundwater management areas

The Lower Murrumbidgee Shallow Alluvium overlies the Lower Murrumbidgee Deep Alluvium and both are identified in Figure 1 as Lower Murrumbidgee Alluvium. The Upper Lachlan Alluvium in Table 1 is broken into eight zones due to the variability in the GWMA.

Assessment

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

Current monitoring focuses on the influence of groundwater use on groundwater levels. Monitoring is concentrated in the areas of groundwater use for irrigation, and commercial and town water supply. It consists of the monitoring of groundwater levels and metering of use.

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 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 New South Wales 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 Lachlan region are described in Table 2.

Table 2 Description of condition indicators







Indicator	Description
Extraction vs LTAAEL	The total annual usage compared with 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 Lachlan region are generally in good to very good condition (see Table 3). It is the alluvial GWMA that have the lowest condition rankings. The localised clustering of groundwater use in some of these GWMA (such as the Lower Lachlan Alluvium and some of the zones in the Upper Lachlan Alluvium) is causing large variations and declines in groundwater levels.

At a GWMA scale, groundwater use is having an impact on groundwater levels and the behaviour of aquifers. These impacts are likely to cause minimal harm to GDEs and the aquifer system. The very poor condition of the extraction vs LTAAEL indicator for the Belubula Valley Alluvium GWMA (Table 3) is due to the assessment of LTAAEL being based only on annual average rainfall recharge and does not include natural river leakage into the aquifer.

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																						
002 Lower Murrumbidgee Deep Alluvium		H	?		H	↑		H	↑		H	↑		M	?		M	↔		H	↑	
002 Lower Murrumbidgee Shallow Alluvium		H	?		H	↑		H	↑		H	↑		M	?		M	↔		H	↑	
011 Upper Lachlan Alluvium Zone 1					H	↑		H	↔		H	↓		L	?		M	↔				
011 Upper Lachlan Alluvium Zone 2					H	↑		H	↔		H	↓		L	?		M	↔				
011 Upper Lachlan Alluvium Zone 3					H	↑		H	↔		H	↓		L	?		M	↔				
011 Upper Lachlan Alluvium Zone 4					H	↑		H	↔		H	↓		L	?		M	↔				
011 Upper Lachlan Alluvium Zone 5					H	↑		H	↔		H	↓		L	?		M	↔				
011 Upper Lachlan Alluvium Zone 6					H	↑		H	↔		H	↓		L	?		M	↔				
011 Upper Lachlan Alluvium Zone 7					H	↑		H	↔		H	↓		L	?		M	↔				
011 Upper Lachlan Alluvium Zone 8					H	↑		H	↔		H	↓		L	?		M	↔				
012 Lower Lachlan Alluvium		H	?		H	↑		H	↑		H	↑		M	?		M	↔		H	↑	
021 Belubula Valley Alluvium		L	L		H	↔		H	↔		H	↔		M	?		M	↔		M	↔	
801 Orange Basalt					M	↑		H	↔		M	↔		L	?		H	↔		M	↔	
802 Young Granite					M	↑		H	↔		M	↔		L	?		H	↔		M	↔	
811 Lachlan Fold Belt - Lachlan Catchment					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		

Groundwater resources in the region are generally not overused. The highest use is occurring in the Lower Murrumbidgee Deep Alluvium GWMA, which is predominantly within the Murrumbidgee region. The level of groundwater use in the catchment is shown in Figure 2.

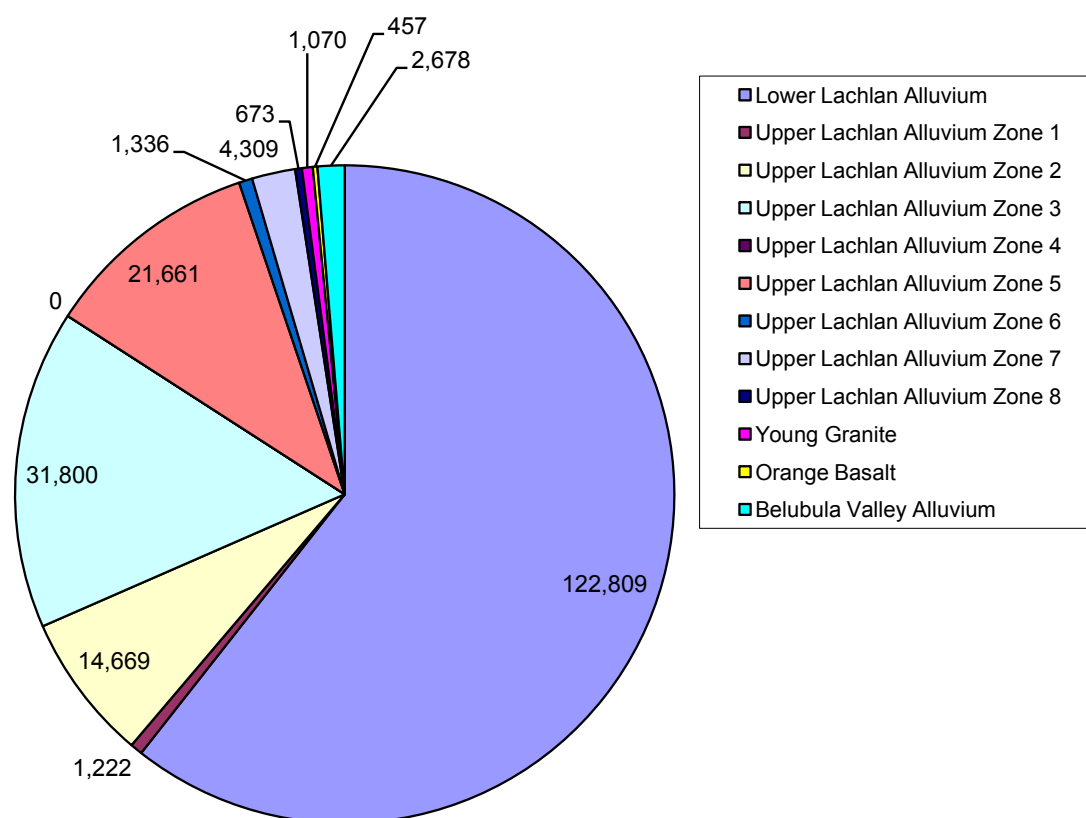


Figure 2 2007–08 metered groundwater use in the Lachlan region (megalitres)

There are significant knowledge gaps in relation to the location, condition and water requirements of GDEs. This is reflected in the assessment of GDE condition in Table 3. In localised areas where there are concerns regarding the potential impact of groundwater use on GDEs, appropriate licence conditions, such as setting a minimum distance between a bore and a GDE, are implemented to limit the impact of groundwater extraction on groundwater levels and water quality.

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.

Irrigation and dryland agriculture have caused shallow watertables and saline outbreaks on the slopes and within Jemalong irrigation area. The current drought conditions have assisted in reducing these shallow watertables and the influence of salinity is therefore declining.

The level of confidence in the information is generally moderate to high due to the number of groundwater level monitoring sites in the region and the metering of high-use groundwater users.

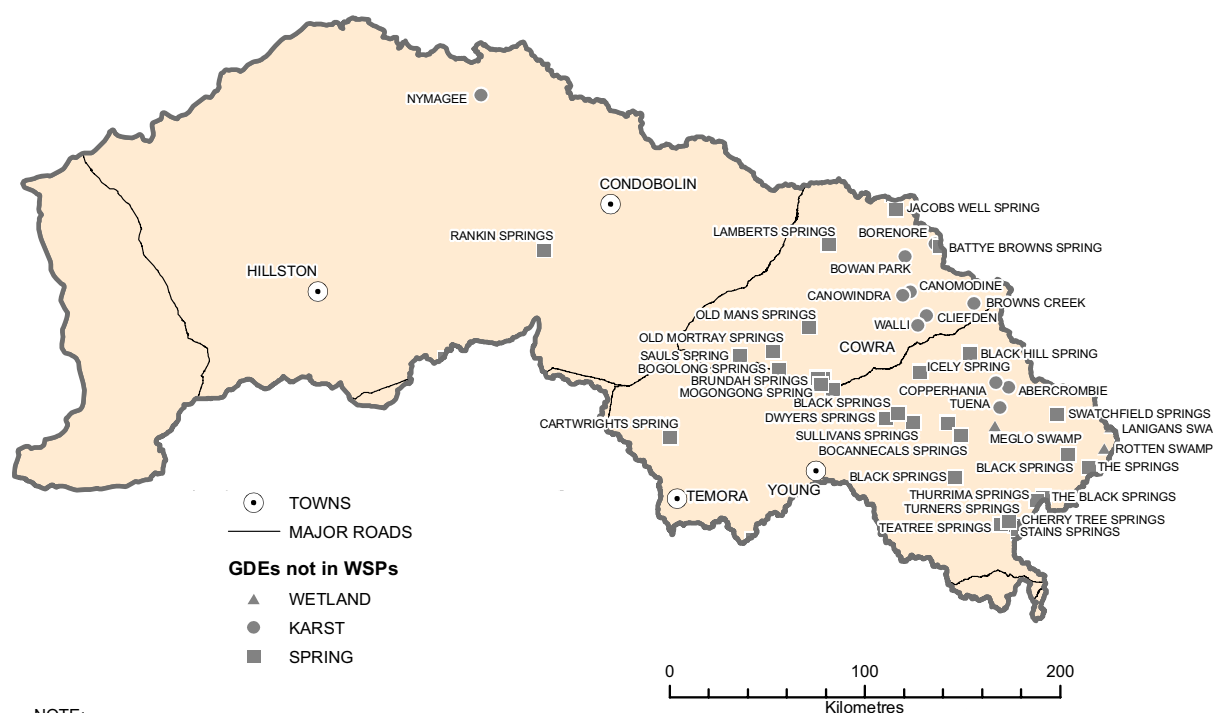


Figure 3 High priority identified GDEs

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 Lachlan region are described in Table 4.

Table 4 Description of pressure indicators

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	<p>Potential contamination of groundwater from:</p> <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 main pressures in the region are land-use change, groundwater use in some GWMA's and the level of entitlement compared with the LTAAEL (see Table 5). The main land-use change pressures are river regulation and agriculture. River regulation has altered the natural behaviour and its relationship with the associated groundwater aquifers. This has altered the surface water groundwater interaction with the river system. Agriculture has altered the amount of water that leaks through the root zone from rainfall and through irrigation.







The areas of the region where groundwater use is placing pressure on GWMA's are the Lower Lachlan, Upper Lachlan Zone 3 and Belubula Valley. In these GWMA's, there are localised concentrations of groundwater use, which are causing either large annual variations or long-term declines in groundwater levels.

The level of groundwater entitlement compared with the LTAAEL in the Young Granite and Upper Lachlan Alluvium GWMA's indicates that full use in these areas may affect the condition of the GWMA's. The implementation of a water management plan in the Lower Lachlan Alluvium GWMA will ensure that use does not exceed the LTAAEL by 2018.

There is limited knowledge on the location of GDEs within the region, especially terrestrial ecosystems. Their identification is required prior to any assessment of the pressure on these systems being conducted.

Table 5 Groundwater source pressure summary

	GDE Groundwater Availability		Land-use Pressures		Regional Impacts		Localised Impacts		Groundwater Quality Impacts		Aquifer Structure Pressures		Entitlement/Share Component to the LTAAEL		GWMA Pressure Index	
GWMA no. and name	Data Confidence	Trend	Data Confidence	Trend	Data Confidence	Trend	Data Confidence	Trend	Data Confidence	Trend	Data Confidence	Trend	Data Confidence	Trend		
002 Lower Murrumbidgee Deep Alluvium			M	↑	H	↑	H	↔	L	?	M	?	H	↑		
002 Lower Murrumbidgee Shallow Alluvium			M	↑	H	↑	H	↑	L	?	M	?	H	↑		
011 Upper Lachlan Alluvium Zone 1			M	↑	H	↑	H	↑	L	?	M	?	H	↑		
011 Upper Lachlan Alluvium Zone 2			M	↑	H	↑	H	↑	L	?	M	?	H	↑		
011 Upper Lachlan Alluvium Zone 3			M	↑	H	↑	H	↑	L	?	M	?	H	↑		
011 Upper Lachlan Alluvium Zone 4			M	↑	H	↑	H	↑	L	?	M	?	H	↑		
011 Upper Lachlan Alluvium Zone 5			M	↑	H	↑	H	↑	L	?	M	?	H	↑		
011 Upper Lachlan Alluvium Zone 6			M	↑	H	↑	H	↑	L	?	M	?	H	↑		
011 Upper Lachlan Alluvium Zone 7			M	↑	H	↑	H	↑	L	?	M	?	H	↑		
011 Upper Lachlan Alluvium Zone 8			M	↑	H	↑	H	↑	L	?	M	?	H	↑		
012 Lower Lachlan Alluvium			H	↑	H	↑	H	↑	L	?	M	?	H	↑		
021 Belubula Valley Alluvium			M	↑	H	↑	H	↓	M	?	M	?	H	↑		
801 Orange Basalt			M	↓	H	↑	M	↔	L	?	H	?	H	↑		
802 Young Granite			M	↓	M	↔	H	↑	L	?	H	?	H	↑		
811 Lachlan Fold Belt - Lachlan Catchment			M	↓	M	↔	M	↔	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 Lachlan Catchment Action Plan can be found at www.lachlan.cma.nsw.gov.au/about/catchmentactionplan.aspx.

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.

Land-use pressures

Groundwater systems in the Lachlan region are influenced by land-use activities such as the regulation of the Lachlan River and land clearing. Saline outbreaks occur in the mid and lower slopes of the region. The driver for these outbreaks is recharge to the aquifer system, which is increasing groundwater levels, causing shallower watertables and raising salinity generally in the lower areas of the landscape.

Management activities in the region include:

- a groundwater monitoring project by the Lachlan Catchment Management Authority (CMA) which established strategic groundwater and salinity monitoring in two of the high priority areas in the Lachlan region (Lake Cargelligo to Tullibigeal area and Young area)
- investment by the Lachlan CMA in revegetation and the management of remnant vegetation and perennial pastures in dryland areas.

Groundwater use and entitlement

The groundwater target is being addressed at the state level through water sharing plans (WSP) 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 level 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 being undertaken to meet this challenge include:

- 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.

The Lachlan CMA is working with natural resource management partners and Carrathool Shire Council to implement the Achieving Sustainable Groundwater Entitlements scheme, which is part of the implementation of a groundwater sharing plan.

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

- expansion of the existing groundwater level monitoring network
- implementation of telemetered time series groundwater level monitoring sites in the inland alluvial WSP 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.

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.

CSIRO 2008, *Water availability in the Lachlan. A report to the Australian Government from the CSIRO Murray–Darling Basin Sustainable Yields Project*, Commonwealth Scientific and Industrial Research Organisation, Australia.

DWE 2008, *Process to Identify Potential and Known High Priority Groundwater Dependent Ecosystems*, Department of Water and Energy, Armidale, unpublished.

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