

State of the catchments 2010

Groundwater

Murrumbidgee 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 pollutants. Groundwater pollution can take many forms, ranging from saltwater intrusion and the release of matrix elements such 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 Murrumbidgee region there are alluvial, fractured rock and porous 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 Murrumbidgee region

Alluvial GWMAs	Fractured rock GWMAs	Porous rock GWMAs
Lower Murrumbidgee Shallow Alluvium*	Lachlan Fold Belt	Western Murray
Lower Murrumbidgee Deep Alluvium*	Young Granite	
Mid Murrumbidgee Alluvium	Yass Catchment	
Lower Lachlan Alluvium		
Bungendore Alluvium		

* These areas are part of the same GWMA, although under water sharing plans (WSPs) they are considered separate water sources due to the significant difference between the aquifer systems.

The highest yielding and most actively used bores in the region are located in the alluvial aquifers. The Lower Murrumbidgee Shallow Alluvium and Lower Murrumbidgee Deep Alluvium have a water management plan, which commenced in October 2006. A status report for the Lower Murrumbidgee Alluvium (Kumar 2009) provides more information and is included in the 'further reading' section. 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.

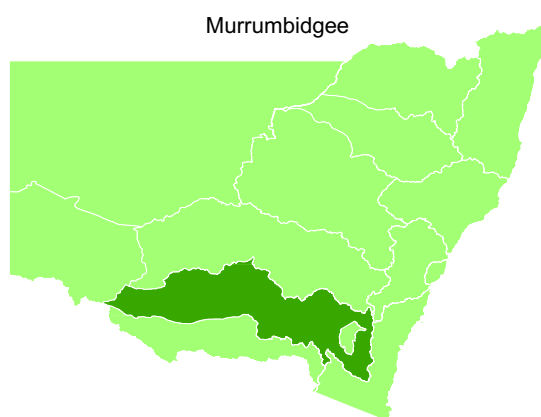
The plan reduces the level of water entitlement over ten years to the LTAAEL. Licence holders have also received structural adjustment through the Achieving Sustainable Groundwater Entitlements (ASGE) scheme to alter their enterprises to the reduced level of entitlement.

The Mid Murrumbidgee Alluvium, Bungendore Alluvium, Yass Catchment and Young Granite are also areas of high groundwater use and entitlement. The Mid Murrumbidgee Alluvium GWMA is a high yielding aquifer. A status report for the Murrumbidgee Alluvium (DWE 2007) provides more information and is included in the 'further reading' section of this report. The water is mainly used for the irrigation of large areas, such as crops and pasture. In the Young Granite GWMA the groundwater is used for the irrigation of cherries. In the Bungendore Alluvium and Yass Catchment GWMA, the majority of the groundwater use is for the supply of domestic water either for towns or rural residential areas.

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

Map of the catchment



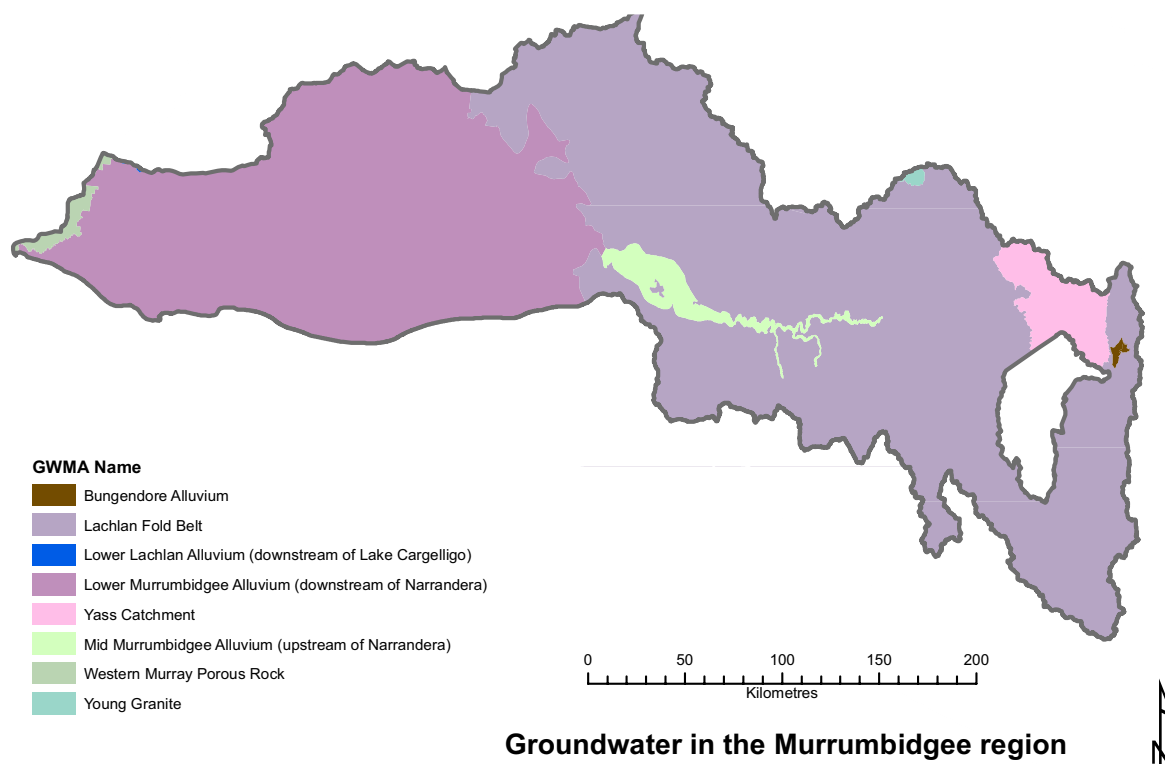


Figure 1 Murrumbidgee region groundwater management areas

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 Murrumbidgee 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 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 Murrumbidgee 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 Murrumbidgee region are generally in good to very good condition (see Table 3). There is a very poor condition ranking for the local groundwater levels indicator in the Lower Murrumbidgee Deep Alluvium and the Mid Murrumbidgee Alluvium GWMA. This is causing large variations and declines in groundwater levels.

Groundwater resources in the region are generally not overused. The highest use is occurring in the Lower Murrumbidgee Alluvium, Lower Lachlan Alluvium and Mid Murrumbidgee Alluvium GWMA. The level of metered groundwater use in the region is shown in Figure 2.

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. The GDEs identified in Figure 3 in the Lower Murrumbidgee Deep Alluvium GWMA and Lower Murrumbidgee Shallow Alluvium GWMA, were not identified at the time of release of the Lower Murrumbidgee Alluvium water sharing plan.

Irrigation and dryland agriculture have caused shallow watertables and saline outbreaks on the slopes and within the Murrumbidgee irrigation area. Below average rainfall since 2002 has 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.

Table 3 Groundwater source condition summary

	GDE Condition			Landscape Condition			Regional Groundwater Levels			Local Groundwater Levels			Groundwater Quality			Aquifer Integrity			Percentage Use to the LTAAEL			GWMA Condition Index		
	Data	Confidence	Trend	Data	Confidence	Trend	Data	Confidence	Trend	Data	Confidence	Trend	Data	Confidence	Trend	Data	Confidence	Trend	Data	Confidence	Trend	Data	Confidence	Trend
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	?				
012 Lower Lachlan Alluvium	H	?		H	?		H	?		H	?		M	?		M	?		H	?				
013 Mid Murrumbidgee Alluvium	L	?		H	?		H	?		H	?		M	?		M	?							
054 Bungendore Alluvium	L	?		H	?		H	?		H	?		L	?		M	?							
612 Western Murray Porous Rock	L	?		M	?		H	?		M	?		L	?		H	?		M	?				
802 Yass Catchment				M	?		H	?		M	?		L	?		H	?							
802 Young Granite				M	?		H	?		M	?		L	?		H	?							
811 Lachlan Fold Belt - Murrumbidgee Catchment				M	?		H	?		M	?		L	?		H	?							

Condition



Very good
Good
Fair
Poor
Very poor
No data

Trend

↑ Improving
↔ No change
↓ Declining
? Unknown

Data confidence

H High
M Medium
L Low

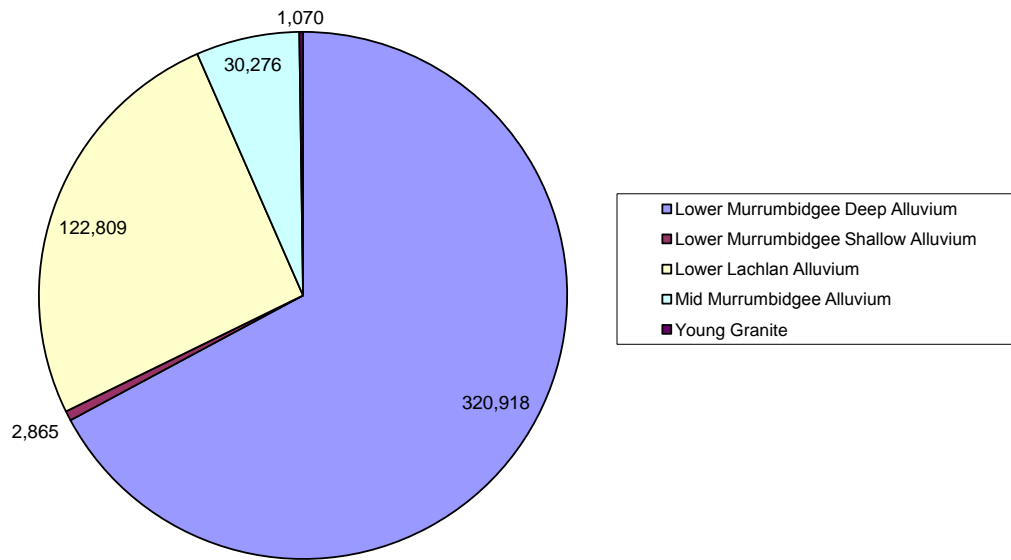


Figure 2 2007–08 metered groundwater use in the Murrumbidgee region (megalitres)

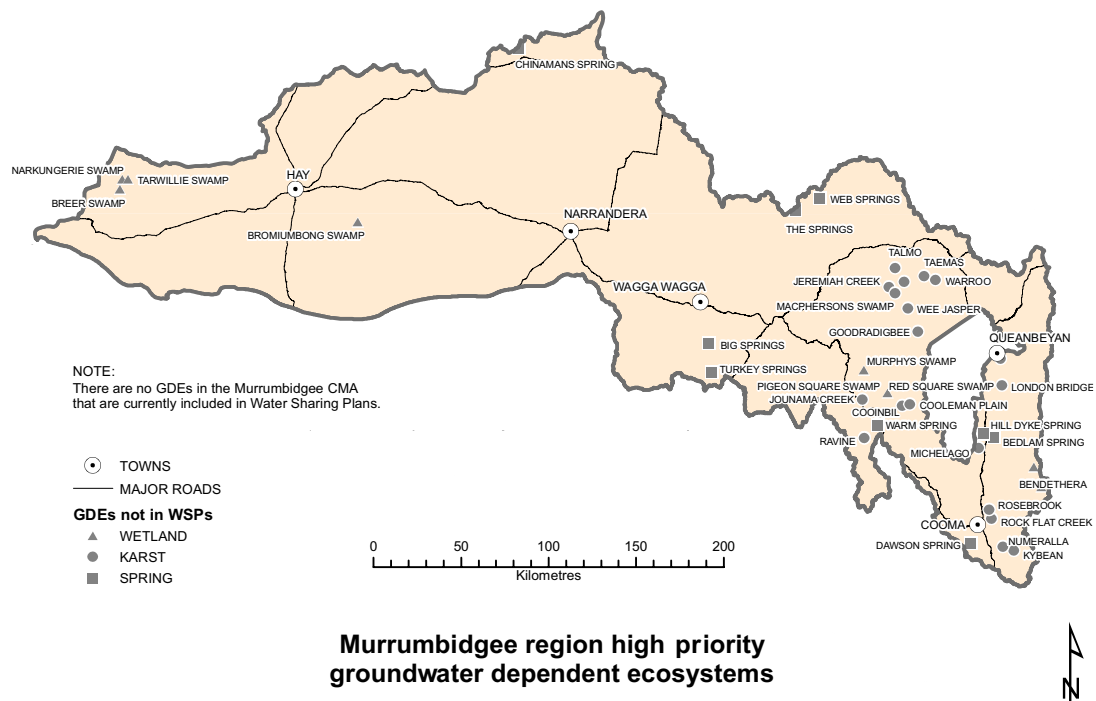


Figure 3 High priority identified GDEs

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 Murrumbidgee 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	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 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 river 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 Murrumbidgee Deep Alluvium and Mid Murrumbidgee Alluvium. 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 Mid Murrumbidgee Alluvium, Young Granite and Bungendore Alluvium GWMA indicates that full use in these areas may affect the condition of the GWMA. The implementation of a water management plan in the Lower Murrumbidgee Deep Alluvium and Lower Murrumbidgee Shallow Alluvium will ensure that use does not exceed the LTAAEL by 2016. In the Yass Catchment GWMA, the concentration of domestic and stock groundwater use (rather than entitlements) is the main pressure.

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

GWMA no. and name	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
	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			H	↑	H	↑	H	↔	L	?	M	?	H	↑	
002 Lower Murrumbidgee Shallow Alluvium			M	↑	H	↑	H	↑	L	?	M	?	H	↑	
012 Lower Lachlan Alluvium			H	↔	H	↓	H	↔	L	?	M	?	H	↑	
013 Mid Murrumbidgee Alluvium			H	↔	M	↔	H	↔	M	?	M	?	H	↔	
054 Bungendore Alluvium			H	↓	M	↔	H	↔	M	?	M	?	H	↔	
612 Western Murray Porous Rock	L	?	H	↓	M	↔	H	↔	L	?	H	?	H	↔	
802 Yass Catchment			M	↑	H	↔	M	↔	L	?	H	?	H	↔	
802 Young Granite			M	↓	M	↔	H	↔	L	?	H	?	H	↔	
811 Lachlan Fold Belt - Murrumbidgee Catchment			H	↓	M	↔	H	↔	L	?	H	?	H	↔	

Pressure		Trend		Data confidence	
	Very low	↑	Increasing	H	High
	Low	↔	No change	M	Medium
	Moderate	↓	Decreasing	L	Low
	High	?	Unknown		
	Very high				
	No data				

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 Murrumbidgee Catchment Action Plan can be found at www.murrumbidgee.cma.nsw.gov.au/about/mcma-cap.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 Murrumbidgee region are influenced by land-use activities such as the regulation of the Murrumbidgee River, irrigation 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.

In the irrigation areas, leakage past the root zone and from irrigation infrastructure exceeds natural rates. This has caused areas to become affected by salinity.

Management activities in the region include:

- the use of efficient irrigation methods to reduce water loss past the root zone
- investment by the Murrumbidgee Catchment Management Authority (CMA) in revegetation and the management of remnant vegetation and perennial pastures in dryland areas
- the identification of saline base flow catchments in the region by the Murrumbidgee CMA to better target natural resource management investment to achieve the CAP targets
- various activities undertaken by Wagga Wagga City Council to reduce the impacts of urban salinity, including revegetation, developing an urban dewatering borefield and consideration of groundwater recharge in approval of new urban developments.

Groundwater use and entitlement

The groundwater target is being addressed at the state level through water sharing plans (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 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 to meet this challenge are 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.

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.

The Murrumbidgee CMA has facilitated community consultation as part of the implementation of the WSP for the Lower Murrumbidgee groundwater water source.

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 Murrumbidgee: A report to the Australian Government from the CSIRO Murray–Darling Basin Sustainable Yields Project*, Commonwealth Scientific and Industrial Research Organisation, Australia.

DWE 2007, *Mid Murrumbidgee Alluvium: Groundwater Management Area 013. Gundagai to Narrandera*. Groundwater Resources Status Report. Department of Water and Energy.

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

Kumar P B 2002, *Lower Murrumbidgee Groundwater Sources: Groundwater Management Area 002*. Groundwater Status Report, NSW Office of Water.

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