



Department of
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Water

Water Sharing Plan for the Murrumbidgee Unregulated and Alluvial Water Sources

Background document for amended plan 2016

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Water Sharing Plan for the Murrumbidgee River Unregulated and Alluvial Water Sources - Background document for amended plan 2016

First published in June 2012

Updated in July 2016 to incorporate amendments to the plan following inclusion of the Adelong, Cotter, Tarcutta and Upper Billabong Water Sources

More information

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Introduction

Water sharing in NSW

Water sharing plans are being progressively developed for rivers and groundwater systems across New South Wales following the introduction of the *Water Management Act 2000* (WMA 2000). These plans protect the health of our rivers and groundwater while also providing water users with perpetual access licences, equitable conditions, and increased opportunities to trade water through separation of land and water. In July 2004, 31 water sharing plans commenced in NSW, bringing these water sources and some 80% of water extracted in NSW under the management and licensing provisions of the WMA 2000.

In recent years, water sharing plans for unregulated¹ rivers and groundwater systems have been completed using a broad scale 'macro' approach based on whole river catchments or aquifer systems. Approximately 95% of the water extracted in NSW is now covered by the WMA 2000. The macro planning process was designed to develop water sharing plans covering most of the remaining water sources across NSW. Each macro plan covers a large river basin rather than a single sub-catchment, or in the case of groundwater systems, cover a particular type of aquifer (for example fractured rock). These macro plans generally apply to catchments or aquifers where there is less intensive water use.

General information on the macro planning process is available in the water sharing plans section of the DPI Water website www.water.nsw.gov.au. This includes:

- *Macro water sharing plans – the approach for unregulated rivers. A report to assist community consultation* – explains the method used to classify and set water sharing rules for unregulated streams across the state
- *Macro water sharing plans – the approach for unregulated rivers. Access and trading rules for pools* – explains the method used to set access and trading rules for pools in unregulated water sources across the state
- *Macro water sharing plans – the approach for groundwater. A report to assist community consultation* – explains the method used to classify and set water sharing rules for groundwater across the state

A series of water policy advisory notes to assist in the development of the water sharing plans

An amended plan for the unregulated Murrumbidgee catchment

The *Water Sharing Plan for the Murrumbidgee Unregulated and Alluvial Water Sources 2012* commenced on 4 October 2012. Until now, water sharing arrangements for the Adelong Creek, Tarcutta Creek and Upper Billabong Creek Water Sources have been covered under separate water sharing plans that commenced in 2004. These plans were amongst the first in NSW and expired in 2016.

In 2013 the Minister approved the replacement of these plans based on reports from the Natural Resources Commission and DPI Water. The Minister directed that any changes to inland plans should be limited due to the impending development of water resource plans under the Murray-Darling Basin Plan. Proposed changes must be permitted under the WMA 2000 and also need to consider the significant amount of consultation which was undertaken in their initial development.

¹ The supply of water in unregulated rivers is typically not controlled by releases of water from dams but rather is dependent solely on rainfall and natural river flows.

The merging of these plans with the more recent Murrumbidgee Unregulated water sharing plan will bring them into line with the current legislative and policy framework for water sharing in NSW. All unregulated water in the Murrumbidgee will now be governed by the one plan. The plan sets the rules for water sharing arrangements until 30 June 2023 providing certainty to water dependant businesses and the environment.

Changes to the provisions of the three replacement plans (Upper Billabong, Adelong and Tarcutta) have occurred for a number of reasons including: changes to policy, updates to legislation, updated data, outcomes of audits, and stakeholder requests. As the provisions in these plan areas have been operating for over a decade, and the initial plans were developed in close consultation with stakeholder groups, DPI Water has aimed to avoid unnecessary changes and focus on improving provisions based on the information sources mentioned above.

The *Water Sharing Plan for the Murrumbidgee River Unregulated and Alluvial Water Sources 2012* (hereafter referred to as the Murrumbidgee Unregulated water sharing plan) covers 43 surface water sources and six groundwater sources. The surface water sources are grouped into six extraction management units and include the three merged water sources and one additional water source (Cotter) which was missed in the original plan.

This document provides background to the development of the rules in the Murrumbidgee Unregulated water sharing plan. It includes information on the purpose of the plan and the policy framework that supports it, a description of the Murrumbidgee catchment including land and water use, and the process of developing the various water sharing rules in the plan. This document is part of a range of material available specifically on the plan including:

- the *Water Sharing Plan for the Murrumbidgee River Unregulated and Alluvial Water Sources* - a legal instrument written in its required statutory format
- *Water sharing plans – Inland unregulated and alluvial water sources – Overview*. A plain English version of the plan explaining the key sections and rules.
- Rule summary sheets for each water source detailing the management rules.

Why are water sharing plans being prepared?

Expansion of water extraction across NSW in the twentieth century has placed most valleys at or close to the limit of sustainable water extraction. This has seen increasing competition between water users (towns, farmers, industries and irrigators) for access to water. This has also placed pressure on the health and biological diversity of our rivers and aquifers.

In December 2000, the NSW parliament passed the WMA 2000 which has the overall objective of “sustainable and integrated management of the State’s water for the benefit of both present and future generations” (DLWC 2001). Water sharing plans play a major role in achieving this objective by providing a legal basis for sharing water between the environment and consumptive water users.

Under the WMA 2000, water sharing plans must protect water sources and their dependent ecosystems, and must protect the basic rights of landholders to extract water. In this way, environmental water and basic landholder rights are afforded priority over licensed water extractions. Among licensed water users, priority is given to water utilities and licensed stock and domestic use, ahead of commercial purposes such as irrigation and other industries.

Water sharing plans also recognise the economic benefits that commercial users such as irrigation and industry can bring to a region. When a plan commences, access licences held under the *Water Act 1912* are converted to access licences under the WMA 2000 which separates the water licences from land tenure. This facilitates the trade of access licences

and encourages more efficient use of water resources. It also allows new industries to develop as water can move to its highest value use.

In conjunction with the WMA 2000, water sharing plans also set rules so that commercial users can continue to operate productively. In general, commercial licences under the WMA 2000 are granted in perpetuity, providing greater commercial security of water access entitlements. Water sharing plans define the access rules for commercial users for ten years providing all users with greater certainty regarding sharing arrangements.

Benefits for water users

The introduction of water sharing plans will benefit water users by providing:

- greater certainty by setting water sharing arrangements for a 10 year period
- clear trading and access rules which will help foster trading of water
- greater security with existing water licences converted to perpetual water access licences under the WMA 2000

Environmental considerations

Water sharing plans are required to reserve water for the overall health of the river and to protect specific ecosystems that depend on river flows, such as wetlands, lakes, estuaries and floodplains. This share of water reserved for the environment is also intended to sustain the river system's aquatic fauna and flora.

Unregulated streams

Rivers naturally experience a range of flows which are necessary for different hydrologic, geomorphic, biological and chemical processes to occur. Flood flows are required to scour channels, rework sediments, and inundate floodplains; medium flows oxygenate water and allow fish passage; and low flows maintain connectivity and assist the survival of aquatic and riparian flora and fauna. To preserve a healthy river system this range of stream flows must be maintained.

Unregulated streams in western NSW experience long periods of no flow interspersed with rare flows of varying magnitude. Fauna and flora have evolved with these conditions and depend heavily on river pools and lagoons which provide refuge during the extended periods of low rainfall and runoff.

In order to protect a proportion of these flows for the benefit of the environment, the Murrumbidgee Unregulated water sharing plan imposes access restrictions on days when stream flows are low. This is achieved by establishing cease-to-pump rules that require users to stop taking water when flows fall below a set level. All surface water licences are subject to these cease-to-pump rules with limited exceptions for licensed stock, domestic and town water supply purposes, and licenses used for food safety and essential dairy care. Refer to the section "Access to very low flow" for further information.

In addition, 'commence-to-pump' rules in some water sources ensure that freshes are available to the environment by requiring users to only recommence taking water once flow has increased above a specified level.

Alluvial aquifers

Aquifers are underground layers of water-bearing permeable rock or unconsolidated materials (gravel, sand, silt or clay) from which groundwater can be extracted. Aquifers can store large volumes of water, often accumulated over thousands, or tens of thousands of years. Water enters (or recharges) aquifers via rainfall, surface flows from rivers and lakes,

or flow from adjacent aquifers. Water sharing plans aim to achieve sustainable groundwater extraction by limiting extractions to a proportion of the aquifer recharge. The remainder of the recharge is reserved for the environment.

Some alluvial aquifers are highly connected to surface water, so that taking water from one source affects the other. In groundwater systems defined as ‘highly connected’ environmental water may also be protected from extraction through linked cease-to-pump rules to ensure taking groundwater does not adversely affect surface water flows.

The Murrumbidgee Unregulated water sharing plan defines cease-to-pump rules for alluvial aquifers in the plan area. It also includes rules on the location of new works and extraction from existing works to protect high priority groundwater dependent ecosystems and other environmentally sensitive areas such as rivers or streams.

Scope of the plan

The Murrumbidgee Unregulated water sharing plan covers 49 discrete water sources, within what is known as the Murrumbidgee and Murray Water Management Areas: Incorporating these resources into the one plan recognises their interaction and allows for the development of water sharing rules that are linked and equitable within and between these water sources.

The amended plan now covers all of the unregulated rivers of the Murrumbidgee River and Billabong Creek catchments. It also covers the water contained in Tala Lake, Talpee Creek and Five Mile Lagoon within the Lowbidgee Flood Control and Irrigation District.

The plan covers the alluvial aquifers of the Billabong Creek, Bungendore and Mid Murrumbidgee alluvial groundwater management areas.

The plan does not cover the Murrumbidgee River Regulated Water Source, the water contained in channels used for the purposes of conveying water within the area of operations of an irrigation corporation, or the majority of water contained in the Lowbidgee Flood Control Irrigation District. The waters within the borders of the ACT do not form part of this plan.

The plan does not cover the following groundwater sources:

- the Lower Murrumbidgee Groundwater Sources
- the Lower Murray Groundwater Source
- the Murray Unregulated and Alluvial Water Sources
- the NSW Murray-Darling Basin Fractured Rock Groundwater Sources
- the NSW Murray-Darling Basin Porous Rock Groundwater Sources

Water management units

Water sharing plans are developed using various water management units: water sources, management zones and extraction management units.

The plan area is divided into **water sources**, which often coincide with sub-catchment boundaries. It is at the water source level that water sharing rules are developed. There are 49 water sources in the Murrumbidgee Unregulated water sharing plan. Of these, 43 are surface water sources and six are groundwater sources.

Water sources can be subdivided into **management zones** where finer resolution of rules is required. There are 18 management zones within the plan.

Where appropriate, **extraction management units** (EMUs), consisting of one or several water sources, may be specified for the purpose of establishing a geographic area over

which long-term average annual extraction limits (LTAAELs) apply. There are four EMUs in the plan.

A map of the plan area is provided in Appendix 1 and a list of the water management units are provided below in Table 1.

Table 1: Water management units in the amended Murrumbidgee Unregulated water sharing plan

Extraction management unit	Water source	Management zone
Surface Water		
Unregulated Billabong Extraction Management Unit	Burrumbuttock Water Source	
	Lower Billabong Water Source	Lower Billabong Creek Nowranie Creek
	Middle Billabong Water Source	Billabong Creek upstream of Culcairn Billabong Creek downstream of Culcairn
	Mountain Water Source	
	Ten Mile Water Source	
	Upper Billabong Water Source	
	Upper Wangamong Water Source	
	Urana Water Source	
	Yarra Yarra Water Source	
Unregulated Murrumbidgee Above Burrinjuck Dam Extraction Management Unit	Bredbo Water Source	
	Burrinjuck Dam Catchment Water Source	
	Cotter Water Source	
	Goodradigbee Water Source	
	Lake George Water Source	
	Molonglo Water Source	
	Murrumbidgee I Water Source	
	Murrumbidgee II Water Source	
	Murrumbidgee III Water Source	
	Numeralla East Water Source	
	Numeralla West Water Source	Cooma Bunyan
	Queanbeyan Water Source	
	Tantangara Water Source	
	Yass Lower Water Source	
	Yass Upper Water Source	Yass River upstream of Gundaroo gauge Yass River downstream of Gundaroo gauge

Extraction management unit	Water source	Management zone
Unregulated Murrumbidgee Below Burrinjuck Dam to Gogeldrie Extraction Management Unit	Adelong Creek Water Source	
	Adjungbilly / Bombowlee / Brungle Water Source	Adjungbilly Creek Brungle Creek Bombowlee Creek Killimcat Creek Oak Creek
	Billabung Water Source	
	Burkes / Bullenbung Water Source	
	Gilmore / Sandy Water Source	
	Goobarragandra Water Source	
	Hillas Water Source	
	Houlaghans Water Source	
	Jugiong Water Source	Demondrille Creek Currawong Creek Jugiong Tributaries
	Kyeamba Water Source	
	Murrumbidgee Central (Burrinjuck to Gogeldrie) Water Source	
	Muttama Water Source	
	Tarcutta Creek Water Source	Borambola Westbrook Umbango
	Upper Tumut Water Source	
Unregulated Murrumbidgee Gogeldrie to Weimby Extraction Management Unit	Lower Billabong Anabranh Water Source	
	Murrumbidgee (Gogeldrie to Waldaira) Water Source	
	Murrumbidgee (Balranald to Weimby) Water Source	
	Murrumbidgee North Water Source	
	Murrumbidgee Western Water Source	
Groundwater		
N/A	Billabong Creek Alluvial Groundwater Source	
N/A	Bungendore Alluvial Groundwater Source	
N/A	Gundagai Alluvial Groundwater Source	Jugiong Alluvial Tarcutta Alluvial
N/A	Kyeamba Alluvial Groundwater Source	
N/A	Mid Murrumbidgee Zone 3 Alluvial Groundwater Source	
N/A	Wagga Wagga Alluvial Groundwater Source	

Note: New water sources are shaded in grey

Objectives of the plan

The objectives of the Murrumbidgee Unregulated water sharing plan are to:

- protect, preserve, maintain and enhance the important river flow dependent and high priority groundwater dependent ecosystems of these water sources;
- protect, preserve, maintain and enhance the Aboriginal, cultural and heritage values of these water sources;
- protect basic landholder rights;
- manage these water sources to ensure equitable sharing between users;
- provide opportunities for enhanced market based trading of access licences and water allocations within environmental and system constraints;
- provide water allocation account management rules which allow sufficient flexibility in water use;
- contribute to the maintenance of water quality;
- provide recognition of the connectivity between surface water and groundwater;
- adaptively manage these water sources; and
- contribute to the “environmental and other public benefit outcomes” identified under the “Water Access Entitlements and Planning Framework” in the Intergovernmental Agreement on a National Water Initiative (2004).

Description of the plan area

The Murrumbidgee River

The area covered by the Murrumbidgee Unregulated water sharing plan comprises the Murrumbidgee catchment and the adjoining Billabong Creek catchment. In total the plan area contains 43 unregulated surface water sources covering an approximate area of 84,000 km², as well as six alluvial groundwater sources. The plan area is located in the south west of NSW and includes the major towns of Balranald, Hay, Griffith, Leeton, Narrandera, Wagga Wagga, Gundagai, Tumut, Cootamundra, Queanbeyan, Yass and Cooma.

The Murrumbidgee River catchment stretches from the Snowy Mountains in the south-eastern part of the catchment and extends to the Riverine plain in the west. The plan area is bounded to the east by the Great Dividing Range, to the north by the Lachlan catchment, to the west by the Lower Murray Darling catchment and to the south by the Murray catchment. The region varies from steep terrain in the east to open plains in the west.

The plan can be divided into three main areas, the catchment above Burrinjuck Dam, the unregulated tributaries below Burrinjuck Dam, and the Billabong Creek catchment.

The major river systems above Burrinjuck Dam are the Murrumbidgee, Bredbo, Numeralla, Queanbeyan and Molonglo Rivers above the ACT and the Yass and Goodradigbee Rivers below the ACT.

The major tributaries that enter the Murrumbidgee River below Burrinjuck Dam are the Tumut River and Jugiong, Muttama, Billabung, Hillas, Gilmore, Houlaghans, Burkes, and Kyeamba Creeks. The waters in the Tumut River and the Murrumbidgee River below Burrinjuck Dam do not form part of this water sharing plan. They are included in the *Water Sharing Plan for the Murrumbidgee Regulated River Water Source 2016*. The water in the unregulated tributaries of the Tumut River such as the Upper Tumut, Goobarragandra, Adjungbilly, and Gilmore Creeks do form part of this water sharing plan.

The major outflowing rivers below Burrinjuck Dam such as Yanco Creek are included in the Murrumbidgee Regulated water sharing plan but any waters west of the Houlaghans and Urana water sources that do not form part of the regulated system are captured within this water sharing plan.

The major river systems within the Billabong Creek catchment are the Billabong, Yarra Yarra, Ten Mile, Mountain, Urangeline, and Wangamong Creeks.

The Upper Murrumbidgee catchment (above Burrinjuck Dam) has its flow regulated by releases made from Tantangara Reservoir but forms part of this water sharing plan. In the mid and lower catchment the flow in the Murrumbidgee River is regulated by Burrinjuck and Blowering Dams.

High environmental value areas

The Murrumbidgee catchment supports a range of natural ecosystems which are dependent on the rivers, creeks and aquifers. These include significant wetland habitats, alpine habitats, aquatic ecological communities, and extensive areas of riparian river red gum forest.

Eight of the unregulated surface water sources within the Murrumbidgee Unregulated water sharing plan have been identified as having high instream values. These are:

- Adelong Creek;
- Burrinjuck Dam Catchment;
- Goodradigbee;

- Murrumbidgee I;
- Murrumbidgee II;
- Murrumbidgee III;
- Queanbeyan; and
- Upper Tumut.

Water sources identified as having high instream value tend to be those water sources where threatened species are present. The identified threatened species of all unregulated river water sources is listed in Appendix 2 (with exception of replacement water sources).

For the three water sharing plans replaced in 2016, instream value assessments were updated with new data available in these water sources. Adelong Creek was identified as having high instream values, Tarcutta Creek as having medium instream values and Upper Billabong as having low instream values.

Some of the important features within the valley include:

- The Lowbidgee Floodplain – Located between Maude and Balranald, the floodplain covers more than 2,000 km² and includes the second largest river red gum forest in Australia and significant black box, lignum and reed-bed communities. The wetlands support large numbers of waterbirds, many of which breed in the extensive lignum swamps, and provide habitat for many threatened species. The Lowbidgee wetlands are included in the Register of the National Estate under the listing for the nearby Great Cumbung Swamp (in the Lachlan Valley) (Department of Environment 2010).
- The Mid-Murrumbidgee wetlands - a network of riverine lagoons and billabongs that occur between Narrandera and Carathool. These wetlands rarely dry out completely and provide drought refuge for a wide range of species including many listed as endangered or threatened.
- Fivebough Swamp is a permanent fresh to brackish, shallow wetland and Tuckerbil Swamp is a seasonal, shallow, brackish to saline wetland. Located on the riverine plains near Leeton, they are of national and international importance because of the abundance and diversity of waterbirds that they support, including migratory shorebirds and threatened species. Fivebough and Tuckerbil Swamps are listed as internationally significant under the Ramsar Convention.
- Sixteen wetlands in the Murrumbidgee valley are listed as nationally significant in the Directory of Important Wetlands (Department of Environment 2010). Table 2 provides a list of these significant wetlands.
- Alpine habitats - Kosciusko National Park protects 2,630 km² of the Murrumbidgee catchment including the headwaters of the Murrumbidgee and Tumut Rivers. This park is nationally and internationally recognised as a UNESCO Biosphere Reserve. It contains nine wilderness areas, and its alpine and sub-alpine areas contain plant species found nowhere else in the world. The Goobarragandra and Goodradigbee Rivers are classified as “Wild and Scenic” Rivers due to their alpine environmental values. This area also contains the threatened ecological community *Montane Peats and Swamps of the Upper Murrumbidgee*. This plant community is associated with accumulated peaty or organic-mineral sediments on poorly drained flats in the headwaters of streams. Montane peatlands and swamps provide habitat for a range of threatened fauna, particularly amphibians and, notably the Northern and Southern Corroboree Frogs and the Giant Dragonfly.

- The Lower Murray River aquatic ecological community is listed as an endangered ecological community in NSW under the *Fisheries Management Act 1994*. It includes all natural creeks, rivers, and associated lagoons, billabongs and lakes of the regulated portions of the Murray River below Hume Weir, the Murrumbidgee River below Burrinjuck Dam, and the Tumut River below Blowering Dam. These lowland environments typically have meandering channels and wide floodplains, and provide a range of aquatic habitats including pools, riffles, billabongs, snags and aquatic plants. The ecological community includes all native fish and aquatic invertebrates within these river reaches, and includes 23 native fish species and over 400 recorded native invertebrate species.

Table 2: Significant wetlands in the Murrumbidgee catchment

Source: Directory of Important Wetlands in Australia (Department of Environment 2010)

Wetland	Location	Description
Bethungra Dam Reserve	Wandalybringel Creek, 17 km SW Cootamundra	Artificial pondage supporting large waterbird population
Big Badja Swamp	Big Badja River, 40 km NE Cooma	Subalpine peat swamp
Black Swamp and Coopers Swamp	Delta Creek, 60 km E Hay	Terminal swamps of canegrass, lignum and black box
Coopers Swamp	Queanbeyan River, 65 km SE Canberra	Upland peat swamp
Coree Flats	Coree Creek, Brindabella National Park, 30 km W Canberra	Wet tussock swamp with sphagnum bogs
Doodle Comer Swamp	Henty township	Shallow basin receiving local runoff
Fivebough Swamp	1 km NE Leeton	Shallow fresh-brackish basin
Lowbidgee Floodplain	Between Maude and Balranald	Large floodplain of effluent creeks, swamps and lakes
Lower Mirrool Creek Floodplain	Mirrool Creek, 30 km NE Griffith	Creek system and floodplain wetlands including Narrabri Swamp and Berangerine Swamp
Micalong Swamp	Micalong Creek, 29 km E Tumut	Large montane peat swamp dominated by sedges
Mid-Murrumbidgee Wetlands	Murrumbidgee River between Narrandera and Carathool	Series of lagoons with river red gum forest
Monaro Lakes	Monaro tablelands 28 km N Cooma to 15 km S Bombala	Series of ephemeral to permanent upland lakes and swamps (some outside Murrumbidgee catchment)
Snowy Flats	Snowy Flats Creek, 6 km SW Corin Dam in Canberra	Mosaic of sphagnum bogs, wet heath, herbfields and sedgeland
Tomneys Plain	Tomneys Plain Creek, 21 km NE Tumbarumba	Upland peat swamp dominated by sphagnum hummocks
Tuckerbil Swamp	Leeton	Brackish depression surrounded by saline mudflats
Yaouk Swamp	Yaouk Creek, Scabby Range Nature Reserve, 60 km NW Cooma	Upland peat swamp dominated by tussock grass

Land use history

Prior to European settlement in the early 1800s, the Murrumbidgee catchment was occupied by many large Aboriginal communities. Those that lived in the west on the Riverine Plain and South West Slopes include the Wiradjuri, Nari-Nari, Mudi-Mudi, and the Yida-Yida. The rivers were central to the Aboriginal lifestyle, especially as a source of food. In the highlands east of Tumut the largest Aboriginal communities were the Walgal and Ngarlgo with the Ngunawal in the north of the catchment.

European explorers arrived in the west of the catchment from 1817 when they followed the Lachlan River downstream southwest of Booligal. In the highlands and the South West Slopes explorers arrived from the 1820s.

In the west of the catchment along the Riverine Plain and South West Slopes graziers followed soon after initial exploration. Pastoral runs were established near Yanco and on the Murrumbidgee River as far west as Hay between 1835 and 1839. By 1845 pastoralists occupied most of the river frontage along the Murrumbidgee River; and from there settlement spread north and south of the river along tributaries. Cattle runs were established in Narrandera in 1832 and sheep stations followed by 1840. Increased stock numbers led to occupation of land away from the rivers where wells were sunk, dams built, land cleared and fences erected.

By the 1830s the highlands were occupied by squatter's runs. In the 1840s, cattle were the primary industry but by the 1860s sheep were the predominant stock. During the 1840s to 1860s, mining further increased the population, and crops and orchards were planted from the 1850s and '60s.

The Murrumbidgee Irrigation Area was established in the Riverina in 1912, created by the diversion of water from the Murrumbidgee River near Narrandera. Construction of several dams followed, with Burrinjuck Dam completed in 1928 and Blowering Dam in 1968. The Snowy Mountains Hydro Electric scheme began construction in 1949 and greatly altered the catchment both physically and demographically, with major rivers dammed and the population in the highlands increasing significantly.

The construction of Burrinjuck and Blowering dams, along with irrigation schemes endorsed by the state, allowed rice production to grow into an important industry for the catchment. Increased availability of water due to dams, bore water and better agricultural technology allowed the irrigated area to extend its range, enabling the cultivation of irrigated crops in the plains around Hay. Cotton crops, which are also highly reliant on water, were established in the Riverina in recent years while orchards and vineyards are also a common land use.

The high soil fertility and abundance of water in the Riverina floodplain has made the western area highly productive for plant growth. This has influenced land use in the region in the past 150 years, causing extensive changes in the natural distribution and condition of the vegetation cover. Today the major land uses are; grazing, cereal farming, irrigation farming (including fruit and vegetables), urban, horticulture, forestry and viticulture.

Urban development is scattered across the catchment. Today in excess of half a million people live in the Murrumbidgee catchment (including Canberra's population). The catchment contains the Australian Capital Territory and Wagga Wagga. Other major urban areas include Queanbeyan, Yass, Cooma, Tumut, Griffith, Cootamundra and Hay and there are numerous rural villages throughout the catchment.

Vegetation

Extensive clearing has occurred within the Riverine Plain. The remaining isolated pockets of vegetation indicate that the most widely distributed native vegetation classes on the Riverine Plain were the Box-Gum Woodlands and Grey Box Woodlands.

Within the South West Slopes, woodlands and open woodlands of white box (*Eucalyptus albens*) are dominant. To the west and north these give way to communities of grey box (*Eucalyptus microcarpa*) and white cypress pine (*Callitris glaucophylla*).

In the highlands of the upper catchment localised clearing has occurred. The vegetation types in this area are highly variable and defined by soil type and climate. They include yellow box (*Eucalyptus melliodora*), red box (*Eucalyptus polyanthemos*) and Blakely's red gum (*Eucalyptus blakelyi*), with areas of white box (*Eucalyptus albens*) occupying lower areas. Red stringybark (*Eucalyptus macrorhyncha*), broad-leaved peppermint (*Eucalyptus dives*) and white gum (*Eucalyptus rossii*) associations dominate hills in the west. Brown barrel (*Eucalyptus fastigata*) communities are more common in the east. River oak (*Casuarina cunninghamiana*) is seen along main streams. Grey gum (*Eucalyptus punctata*) and Blaxland's stringybark (*Eucalyptus blaxlandii*) are found on lower areas, and brown barrel, mountain gum (*Eucalyptus dalrympleana*), narrow-leaved peppermint (*Eucalyptus radiata*) and ribbon gum (*Eucalyptus viminalis*) occur on higher areas. Patches of snow gum (*Eucalyptus pauciflora*) occur in the highest places in cold air pockets.

There are areas within the Murrumbidgee catchment that remain vegetated and some of which are protected as National Park, State Forest or smaller Nature Reserve. About 15% of the catchment is managed publicly (including National Parks and Wildlife Service Estate, State Forests, and Crown Lands such as Travelling Stock Routes).

Climate

The climate varies considerably across the Murrumbidgee catchment. The upper catchment has a temperate climate with warm summers in most areas and cool summers in the high altitude areas, cold winters and no dry season. The South West Slopes have a sub-humid climate with hot summers, and the western area has a dry semi-arid climate with hot summers and cool winters.

Rainfall throughout the catchment decreases westward ranging from over 1700 mm in the highlands to less than 300 mm in the west. Rainfall in the west is dominated by summer thunderstorms while winter has a more consistent rainfall. Rainfall is unpredictable across the central and western sections of the catchment and drought is common. In the eastern highlands precipitation occurs all year round but is greatest in winter and spring. During winter, much water is held as snow and ice and held back from streams until it thaws in warmer weather. Stream flows are boosted during early summer, ensuring water availability for most of the year.

January and February are generally the hottest months with mean summer temperatures ranging between 33°C in the west and 16°C at higher altitudes in the east. Mean winter temperatures range from 3°C to 5°C in the west to 0°C to -2°C in the highlands. Frosts occur occasionally in the west over winter and frequently in the highlands over winter but can occasionally occur in all but the warmest months of the year in the highlands. In summer evaporation rates are high in the west resulting in major water loss. In the highlands evaporation remains low all year due to low daytime temperatures.

Climate change and variability

Following the November 2006 water summit on the southern Murray-Darling Basin (the Basin), the then Prime Minister and MDB state premiers commissioned CSIRO to report on sustainable yields of surface and groundwater systems within the Basin. The CSIRO Murray-Darling Basin Sustainable Yields Project assessment was undertaken for 18 regions including the Murrumbidgee. The CSIRO (2008) report made the following conclusions for the Murrumbidgee:

- Current average surface water availability is 4,270 GL/year and a high proportion (53 per cent) of this water is used. Groundwater use is also moderate at about 407 GL/yr or 17% of total water use.
- The average annual rainfall and runoff over the ten-year period 1997 to 2006 are 11% and 31% lower respectively than the long-term (1895 to 2006) average values. Under a long-term continuation of this drier recent climate average surface water availability would reduce by 30%, diversions by 18% and end-of-system flows by 46%. The relative level of use would increase to 62%.
- The best estimate of climate change by 2030 would reduce average surface water availability by 9% and reduce surface water diversions by 2%.
- Likely future development of farm dams would reduce runoff by 1%. Likely commercial plantation forestry expansion will have significant local effects but negligible effects over the entire region. Groundwater extraction is expected to increase by around 22% to become 21% of total average annual water use by 2030.

However, CSIRO (2008) also report that the hydrological impacts of climate change in the Murray-Darling Basin remain very uncertain. Rainfall-runoff modelling with climate change projections from global climate models indicates that future runoff in the Murrumbidgee region is more likely to decrease than increase. The CSIRO (2008) report suggests that the best estimate 2030 climate scenario is a 9% reduction in mean annual runoff. The extreme estimates (from different climate models under high global warming) range from a 31% reduction to a 13% increase in mean annual runoff (CSIRO 2008).

Under the best estimate 2030 climate, there would be a 9% reduction in water availability, a 17% reduction in end-of-system flows and a 2% reduction in surface water diversions overall (CSIRO 2008). Under the wet extreme 2030 climate there would be increases of 13% in average water availability, 20% in end-of-system flows and 5% in surface water diversions (CSIRO 2008). Under the dry extreme 2030 climate there would be decreases of 28% in average water availability, 44% in end-of-system flows and 16% in surface water diversions (CSIRO 2008).

Stream flows

The Murrumbidgee River starts in the Kosciuszko National Park on the Long Plain and flows 1600 km westward to its confluence with the Murray River near Balranald. It has average annual flows of around 4.4 million megalitres. The Murrumbidgee River is a regulated system and has 14 dams and eight large weirs. These dams control water for the Murrumbidgee Irrigation Area and the Coleambally Irrigation Area situated in the lower Murrumbidgee catchment.

The upper Murrumbidgee catchment from Tantangara Dam to Burrinjuck Dam is also regulated but, as it is not regulated by a NSW state authority, it forms part of the unregulated water sharing plan.

Creeks within the Murrumbidgee catchment exhibit variability in stream flows. This variability occurs between seasons and across the catchment. In the wetter months flows are many times greater than the drier months. Those streams located in the eastern part of the catchment where rainfalls are higher exhibit markedly higher flows than those in the western part of the catchment which experiences lower rainfall. In the west of the catchment many streams do not flow for many years at a time and only flow in flood events which also refill man-made and natural off river storages.

There are approximately 100 active river gauges within the Murrumbidgee catchment recording stream flows on a continuous basis. A large proportion of these are on the Murrumbidgee River below Burrinjuck Dam which forms the regulated river system. The Murrumbidgee Unregulated water sharing plan makes use of gauges on the Murrumbidgee River above Burrinjuck Dam and on non-regulated tributaries and effluent creeks downstream of Burrinjuck and Blowering dams. There are 23 gauges used as flow reference points in the plan (Table 3) as well as a number of visible flow points in water sources where no suitable gauge exists.

Table 3: Gauges being used as flow reference points in the plan

Gauge	Water source
Adelong Creek at Batlow Road (410061)	Adelong Creek Water Source
Adjungbilly Creek at Darbalara (The Elms) (410038)	Adjungbilly/Bombowlee/Brungle Water Source
Bombowlee Creek at Bombowlee (410070)	Adjungbilly/Bombowlee/Brungle Water Source
Billabong Creek at Nangus Road (41010705)	Billabong Water Source
Gilmore Creek at Gilmore (Willows) (410059)	Gilmore/Sandy Water Source
Goobarragandra River at Lacmalac (410057)	Goobarragandra Water Source
Goodradigbee River at Wee Jasper (410024)	Goodradigbee Water Source
Hillas Creek at Mt Adrah (410043)	Hillas Water Source
Kyeamba Creek at Ladysmith (410048)	Kyeamba Water Source
Billabong Creek at Walbundrie (410091)	Lower Billabong Water Source
Billabong Creek at Aberfeldy (410097)	Upper Billabong Water Source; Middle Billabong Water Source
Molonglo River at Burbong (410705)	Molonglo Water Source
Murrumbidgee River at Mittagang Crossing (410033)	Murrumbidgee I Water Source
Murrumbidgee River at Billilingra (410050)	Murrumbidgee II Water Source
Murrumbidgee River at Halls Crossing (410777)	Murrumbidgee III Water Source
Numeralla River at Rose Valley low flow (41000206)	Numeralla East Water Source
Cooma Creek at Cooma No 2 (The Grange) (410081)	Numeralla West Water Source
Tarcutta Creek at Old Borambola (410047)	Tarcutta Creek Water Source
Westbrook gauge (410058)	Tarcutta Creek Water Source
Queanbeyan at the ACT Border (410770)	Queanbeyan Water Source
Billabong Creek downstream of Ten Mile and Mountain Creeks (410186)	Ten Mile Water Source; Mountain Water Source
Yass River at Above Macks Reef Road (410851)	Yass Upper Water Source
Yass River at Gundaroo (410090)	Yass Upper Water Source

Groundwater

Only some of the unconsolidated alluvial aquifers in the Murrumbidgee area are covered by the Murrumbidgee Unregulated water sharing plan. Underlying hard rocks and other alluvial sediments are covered by other water sharing plans, including the fractured rocks of the Lachlan Fold Belt and the porous rocks of the Oaklands Basin. The alluvial aquifers covered by this plan are:

- Billabong Creek Alluvium (GWMA 014);
- Bungendore Alluvium (GWMA 054); and
- Mid Murrumbidgee Alluvium (GWMA 013).

Other major unconsolidated alluvial groundwater sources are found underlying part of the plan area such as the Lower Murrumbidgee alluvium but these are dealt with in existing water sharing plans.

Groundwater resources status reports have been undertaken in the Mid Murrumbidgee Alluvium (Groundwater Management Area 013) and the Billabong Creek Alluvium (Groundwater Management Area 014). There are no equivalent reports for the Bungendore Alluvium (Groundwater Management Area 054). However there have been groundwater sustainability investigations, hydrogeological investigations and groundwater flow modelling carried out.

The unconsolidated alluvial aquifers are the major source of groundwater in the Murrumbidgee River catchment.

Mid Murrumbidgee Alluvium – Groundwater Management Area 013

The Mid Murrumbidgee Alluvial Groundwater Management Area is defined as the unconsolidated alluvial deposits associated with the Mid Murrumbidgee and Tumut Rivers. It extends from near Jugiong along the Murrumbidgee River and Tumut along the Tumut River in the east to Narrandera in the west where it meets the Lower Murrumbidgee Alluvium Groundwater Management Area.

The system consists of two aquifers, the lower being the Lachlan formation and the upper the Cowra formation. The Lachlan aquifer is high yielding, contains low salinity water and consists of quartz sands and gravel. This aquifer is used as a town water supply for many towns and villages in the Riverina. The overlying Cowra formation contains mostly clays and silts with minor sand and gravel lenses. It is a low yielding formation and is generally of higher salinity than the Lachlan formation with levels increasing with distance from the Murrumbidgee River and downstream of Wagga Wagga. It is suitable for mostly stock and domestic purposes. The Lachlan formation is a confined aquifer system while the overlying Cowra formation is a semi confined to unconfined aquifer system. The Lachlan formation commences from near Oura east of Wagga Wagga and increases in thickness to about 120m at Narrandera (37 to 160m below ground surface). The Cowra formation extends from ground surface down to varying depths. The formation increases in thickness from Gundagai, where it extends to a depth of about 25m, to about 40m around Narrandera.

The section of the aquifer system along the Murrumbidgee River upstream of the Tarcutta Creek confluence is considered to be highly connected to surface water. For water sharing plans, groundwater sources are considered to be highly connected if 70% or more of the groundwater extracted in an irrigation season comes from surface water sources.

There are 98 monitoring bores in the Mid Murrumbidgee Alluvium. Monitoring of groundwater levels in this area has been occurring since the late 1960s and early 1970s. The monitoring

has shown that there was a significant rise in groundwater levels associated with the 1974 floods after which levels generally declined. The rise in groundwater levels caused by the 1974 flood indicated that the Murrumbidgee River was closely linked to the groundwater system, and that large flood events are a major recharge source for the Mid Murrumbidgee alluvial aquifers. Between 1997 and 2010, groundwater and river levels experienced a declining trend. During this period there was a period of lower river level heights and a measurable influence of groundwater extraction from the Lachlan aquifer (Mitchell 2009).

There has been large scale extraction in the Wagga Wagga area associated with town water supplies. Irrigation has grown significantly between Wagga Wagga and Narrandera since the late 1990s. Increased usage combined with drier periods have seen a lowering of groundwater levels around Wagga Wagga over the years prior to 2010 and a change in the relationship between the Murrumbidgee River and the groundwater system. Monitoring indicates that groundwater levels in the upper aquifer were previously above the river height but in the late 2000s were below the base of the river (Mitchell 2009).

There has been a moderate to high level of development in the groundwater management area. The section around Wagga Wagga experienced declining groundwater levels in the ten years to 2010 with bores impacting each other over one kilometre apart. This section has been separated out within the plan and managed as a single water source to reflect these issues.

Billabong Creek Alluvium – Groundwater Management Area 014

The Billabong Creek Alluvial Groundwater Management Area contains three main unconsolidated alluvial deposits where groundwater occurs up to a depth of about 100m in alluvial formations. They are generally located between 10-20m (Upper Cowra formation), 20-40m (Lower Cowra formation) and 60-100m (Lachlan formation).

The most productive aquifer is the deeper Lachlan formation aquifer. Generally all the aquifers are hydraulically connected to a varying degree so the groundwater source is managed as one aquifer system with management rules equally applying to all aquifers.

The Billabong Creek Alluvial water source is recharged by rainfall, stream flow, and flood events. In the Billabong Creek Alluvial water source connectivity between the Cowra and Lachlan formations is significantly less than the Upper Murray and Mid Murrumbidgee alluviums due to the higher clay content in the Cowra layer. Most high yielding licence holders are located upstream of Morgan's lookout where the unregulated Billabong Creek is a gaining stream. Although the upper reaches gain water from groundwater seepage from the shallow layer, direct connectivity with the deep aquifer is minimal therefore pumping from the deep aquifer is less likely to affect creek flow. A groundwater model for the Billabong aquifer is not available.

There are 16 monitoring bores in the Billabong Creek Alluvium. Investigation drilling began in the early 1960s. Groundwater development for irrigation started only in the late 1990s but town water supply bores have been active for over 20 years. Groundwater pressure levels were falling by 10cm per year on average between the mid-1990s until 2010 however, pressure levels are falling at a faster rate locally in areas of groundwater development, up to 15m per year in areas of high development during a pumping season (NOW 2010).

The upper Cowra Formation experiences low salinity groundwater in the upper part of the catchment and in sand lenses close to the creek where direct river recharge can occur. In the middle and lower part of the catchment the salinities are medium to high due to low hydraulic gradients, low hydraulic connectivity and evapotranspiration effects. The deeper Lachlan Formation has relatively low and consistent salinity levels. There is an increase from east to

west and salinity can go up slightly near localised pumping but can freshen up within a few weeks of the cessation of pumping. There is a salt interception scheme at Morgan's Lookout north of Walla Walla. It taps the deep Lachlan aquifer. Groundwater pumping is required when the creek flow is low to reduce saline groundwater inflow from the shallow aquifer along a 2km stretch of the Billabong Creek.

Bungendore Alluvium – Groundwater Management Area 054

The Bungendore Alluvial Groundwater Management Area is defined as the unconsolidated alluvial deposits extending south from the southern end of Lake George. The area is a small paleo-valley filled with Tertiary deposits to a maximum thickness of about 80m. The valley drains north into the Lake George basin, and is quite narrow and sinuous. Clean quartz sand lenses within a dominantly clayey sequence are useful aquifers, but their extent is limited by the small size and irregular shape of the old valley.

There are six monitoring bores in the Bungendore Alluvium. Monitoring has shown that the influence of extraction is noticeable but there are no declines in groundwater levels that could be directly associated with groundwater extraction. Salinity has not been identified as an issue for water quality.

Water entitlement and use

There are approximately 1,460 water licences (excluding basic landholder rights) in the area covered by the plan, totalling 181,630 ML of entitlement. This entitlement is divided between unregulated surface water (90,491.6 ML) and alluvial groundwater (91,139 ML). The majority of licences are used for irrigation, with a significant proportion also used for town water supply. Prior to the commencement of the plan there was an embargo on granting new water licences in the unregulated system of the Murrumbidgee River catchment and all of the alluvial aquifers.

Detailed water use is not available in the unregulated rivers because there is not yet broad scale metering in these water sources. Water is also extracted from watercourses within the plan area through basic landholder rights (not requiring a licence).

Water extraction in the unregulated water sources

The plan includes 90,491.6 ML of entitlement within the unregulated surface water sources (Table 4). The majority of these water licences are located:

- on the tributaries of the Murrumbidgee River upstream of Gogeldrie Weir;
- along the Murrumbidgee River above Burrinjuck Dam; and
- along the Billabong Creek.

The western part of the plan area contains considerably fewer licences due to the lower rainfalls and lack of defined water courses.

The majority of water used is for irrigation and town water supply. The plan recognises the economic benefits to the region that are generated by commercial users such as irrigators and industry. Four of the 39 unregulated water sources covered by the plan were classified as being of high economic significance to local communities due to their dependence on commercial water extraction:

- Gilmore/Sandy Water Source – relatively high value of irrigated agricultural production associated with orchards;
- Hillas Water Source – relatively high value of irrigated agricultural production associated with orchards;

Table 4: Total entitlement and number of licences for unregulated water sources

Water Source	Entitlement (ML/year)	Number of licences
Adelong	3,875.8	72
Adjungbilly/ Brungle/ Bombowlee	602	17
Billabung	148	5
Bredbo	236.5	8
Burkes/Bullenbung	538.5	18
Burrinjuck Dam Catchment	117	3
Burrumbuttock	0	1
Cotter	0	0
Gilmore/Sandy	4,859.25	87
Goobarragandra	1664	26
Goodradigbee	875	10
Hillas	1,543.1	18
Houlaghans	23	6
Jugiong	2,295.5	47
Kyeamba	423	7
Lake George	340.5	14
Lower Billabong	10,224	100
Lower Billabong Anabranh	1,320	20
Middle Billabong	389	17
Molonglo	506.5	26
Mountain	7	3
Murrumbidgee Central (Burrinjuck to Gogeldrie)	7103	67
Murrumbidgee (Gogeldrie to Waldaira)	15,695	22
Murrumbidgee I	4,048	21
Murrumbidgee II	6,614.5	78
Murrumbidgee III	1,926.2	39
Murrumbidgee (Balranald to Weimby)	0	0
Murrumbidgee North	940	18
Murrumbidgee Western	8,076	23
Muttama	900	22
Numeralla East	4,308.25	60
Numeralla West	350	16
Queanbeyan	435	42
Tantangara	0	0
Tarcutta	5,220	103
Ten Mile	0	0
Upper Billabong Creek	337	4
Upper Tumut	195	2
Upper Wangamong	0	2
Urana	400	37
Yarra Yarra	32	2
Yass Lower	2,158	19
Yass Upper	1,766	126
Total	90,491.6	1,208

- Goobarragandra Water Source – relatively high value of irrigated agricultural production associated with pasture; and
- Numeralla East Water Source – relatively high value of irrigated agricultural production associated with horticulture and lucerne.

Changes to plan entitlement in replacement water sources

Entitlements for Adelong Creek, Tarcutta Creek and Billabong Creek were reviewed during the merge of these water sources into the Murrumbidgee Unregulated water sharing plan. The following changes were made:

- Adelong Creek – entitlement of 4,060 ML/yr was revised to 3,875.8 ML/yr resulting from the cancellation of a local water utility licence during the life of the plan;
- Tarcutta Creek – entitlement of 4,945 ML/yr was revised to 5,220 ML/yr resulting from the issue of new licences during the life of the plan; and
- Upper Billabong – no changes.

These changes were made to reflect the current licensed entitlement in each of these water sources as of September 2014.

The Cotter Water Source which is a new water source included in the plan has no entitlement.

Water extraction in the alluvial groundwater sources

There are currently 252 alluvial groundwater licences within the plan area with an authorised entitlement of 91,139 ML/yr (Table 5).

Table 5: Total entitlement and number of licences for groundwater sources

Groundwater management area	Groundwater source	Entitlement (ML/year)	Number of Licences
Mid Murrumbidgee GWMA	Gundagai	4,012	42
	Kyeamba	2,070	13
	Mid Murrumbidgee Zone 3	48,383	84
	Wagga Wagga	28,584	65
Billabong Creek Alluvium	Billabong Creek	6,872	44
Bungendore Alluvium	Bungendore	1,218	4
	Total	91,139	252

Mid Murrumbidgee (GWMA 013)

The Mid Murrumbidgee (GWMA 013) covers the Gundagai, Kyeamba, Mid Murrumbidgee Zone 3, and Wagga Wagga Alluvial Groundwater Sources. The alluvial groundwater licences in Mid Murrumbidgee are located mainly in the alluvium surrounding the township of Wagga Wagga, where the majority of the entitlement is held by Riverina Water County Council and Goldenfields Water County Council and downstream of Wagga Wagga. The eastern part of the catchment has the least number of alluvial aquifer licences.

Billabong Creek Alluvium (GWMA 014)

The water source is used predominantly for irrigation and town water supply, being the main source of water supply to Holbrook, Culcairn, Walla Walla and Walbundrie townships. There

is a salt interception scheme at Morgan's Lookout and there is some use of the aquifer for industrial purposes.

Bungendore Alluvium (GWMA 054)

A large proportion of the yield available from the Tertiary sand aquifer system is used for the Bungendore town water supply with some used for irrigated agriculture, industry, and stock and domestic use.

Local water utility requirements

There are a large number of town water supply schemes within the Murrumbidgee Unregulated catchment (Table 5).

In the upper catchment above Burrinjuck Dam town water is supplied mostly from storages and direct river extractions. Yass Valley Council supplies many of the towns in the north east including Yass and Bowning from the Yass River. In the upper reaches of the Murrumbidgee River the townships of Cooma and Bredbo are supplied from the Murrumbidgee River by Cooma Monaro Shire Council. Adaminaby was serviced by a dam on the Goorudee Rivulet but is now serviced by a diversion from Lake Eucumbene. In the Molonglo River catchment, Palerang Council supplies water to the Captains Flat area from Captains Flat Dam. Palerang Council also extract from the Bungendore Alluvium to supply Bungendore and its surrounds.

In the Upper Tumut catchment Snowy Hydro Limited supplies town water to Cabramurra from Dry Dam. Tumut Shire Council supplies water to Batlow from Kunama Dam on Little Gilmore Creek and to Talbingo from Jounama Creek.

Downstream of Burrinjuck Dam most towns are supplied from the Regulated Murrumbidgee River. The majority of town water not extracted from the river is in the form of groundwater extracted from the Mid Murrumbidgee and Billabong Creek Alluvial Aquifers.

From the Billabong Creek alluvial aquifer town water is supplied to the area around Ralvona, Walbundrie, and Walla Walla by Riverina Water County Council. Riverina Water County Council also has two surface water licences on Billabong Creek which act as a secondary town water supply. They are to be used when groundwater is unavailable and water use restrictions are such that outside water use is banned. Greater Hume Shire Council supplies Culcairn and Holbrook via a series of bores.

The Mid Murrumbidgee alluvial aquifer is an important source of town water supply, particularly in and around Wagga Wagga. Riverina Water County Council owns a series of bores north, west and east of Wagga Wagga that supply the majority water for the town. This can be supplemented at times by a regulated river surface water licence. Riverina Water County Council also supplies town water from bores at Collingullie, Oura, Tarcutta and Bulgary. Goldenfield's Water County Council extracts from a series of bores at Oura which are used to supply town water to the area around Junee. Additional bores at Mt Arthur supply town water to the Ganmain and Matong areas. Narrandera Shire Council supplies town water to the Narrandera district through extracting groundwater from the Mid Murrumbidgee Alluvium near Narrandera.

As shown in Table 6 extractions for town water supplies constitute a considerable proportion of the total entitlement within some water sources e.g. Molonglo, Murrumbidgee I, Upper Tumut, Yass Lower, Bungendore Alluvial and Wagga Wagga Alluvial. In these water sources competition for water during low flows or peak irrigating times can become an issue between agricultural users and the local water utility. In surface water sources, the water sharing plan allows water utilities to access very low flows when other users cannot.

Table 6: Town water supplies, location and entitlement volume in the plan area

Water source	Water supply	Entitlement (ML/yr)	Percentage of entitlement in water source
Gilmore/Sandy	Kunama Storage Dam (Tumut Shire Council)	516	11%
Jugiong	Illalong Dam (Yass Valley Council)	30	1%
Lower Billabong	Billabong Creek (Riverina Water County Council)	40	<1%
Molonglo	Captains Flat Dam (Palerang Council)	250	49%
Murrumbidgee I	Murrumbidgee River – Mittagang Crossing (Cooma Monaro Shire Council)	2,134	53%
	Goorudee Rivulet – Adaminaby (Snowy River Shire Council)	102	2%
Murrumbidgee II	Murrumbidgee River – Bredbo (Cooma Monaro Shire Council)	5	<1%
Tarcutta	Umbango Creek (Riverina Water County Council)	30	<1%
Upper Tumut	Dry Dam (Snowy Hydro Limited)	60	31%
Upper Tumut	Jounama Creek – Talbingo (Snowy Hydro Limited)	93	48%
Yass Lower	Yass Dam (Yass Valley Council)	1700	79%
Billabong Creek Alluvial groundwater	Walbundrie – Bores (RWCC)	125	2%
	Walla Walla – Bores (RWCC)	400	6%
	Ralvona Bores – (RWCC)	500	7%
	Mt Royal Water Supply Scheme – bores (Private)	30	<1%
	Culcairn – Bores (GHSC)	450	6%
Bungendore Alluvial groundwater	Bungendore bores (Palerang Council / Eastern Capital City Regional Council)	472	39%
Gundagai Alluvial groundwater	Tarcutta – Bores (RWCC)	100	<1%
Wagga Wagga Alluvial groundwater	North, West and East Wagga Wagga - Bores (RWCC)	14,000	51%
	Oura - Bores (RWCC)	200	<1%
	Oura – Bores (GWCC)	6,000	22%
Mid Murrumbidgee Zone 3 Alluvial groundwater	Collingullie – Bores (RWCC)	150	<1%
	Bulgary - Bores (RWCC)	1,000	2%
	Narrandera – Bores (Narrandera Shire Council)	3,000	6%
	Mt Arthur – Bores (GWCC)	762	1%

Policy framework

A number of national, state and regional plans and policies have guided the development of water sharing plans for NSW, including:

- *Water Management Act 2000*;
- *Access Licence Dealing Principles Order 2004*;
- National Water Initiative;
- Murray-Darling Basin Cap Agreement;
- The Basin Plan (*Commonwealth Water Act 2007*);
- Natural Resource Commission state-wide targets;
- Catchment Action Plans; and
- NSW water planning policies and other considerations.

The Water Management Act 2000

The *Water Management Act 2000* (WMA 2000) is based on the concept of ecologically sustainable development i.e. managing current development so that it will not threaten the availability of resources for future generations. The WMA 2000 recognises the need to allocate water for the environmental health of our rivers and groundwater systems, while also providing licence holders with more secure access to water and greater opportunities to trade water through the separation of water access from land title.

Water sharing plans are the main tool through which the WMA 2000 achieves its objective. The major changes required to water management have meant that the WMA 2000 has been progressively implemented, and the *Water Act 1912* progressively phased out as water sharing plans commence.

The latest copy of the [WMA 2000](#) is available from the NSW government legislation website.

Access Licence Dealing Principles

The *Access Licence Dealing Principles Order 2004* (hereafter referred to as the Dealing Principles) draws on the objects and water management principles of the WMA 2000 and provides state-wide guidance and rules for applications to undertake water dealings including trade.

The Dealing Principles specify that dealings must consider:

- the impacts on other water users;
- the impacts on the water source;
- the impacts on indigenous, cultural, heritage and spiritual matters; and
- maximising social and economic benefits.

The Dealing Principles specify rules for different types of dealings (such as conversion to a new category, subdivision, consolidation, assignment of rights or allocation, changing water sources, amending extraction components and interstate dealings). They specify the requirements that must be met for a dealing to be permitted, and the conditions under which a dealing is prohibited.

Water sharing plans must be consistent with the Dealing Principles. Water sharing plans can also put additional restrictions in place such as restricting trade into a particular area due to its environmental values or hydrologic stress.

National Water Initiative

The National Water Initiative (NWI) was signed by the Council of Australian Governments (COAG) in June 2004. Through the NWI, governments across Australia, including NSW, have agreed on actions to achieve a more cohesive national approach to managing, measuring, planning, pricing and trading water. The NWI recognises the continuing need to increase the productivity and efficiency of Australia's water use, whilst servicing rural and urban communities, and ensuring the health of river and groundwater systems.

The NWI sets out guidelines, outcomes and timelines for water plans and planning processes. Until 2014 the NWI was implemented and monitored by the National Water Commission, an independent statutory body responsible for providing advice to COAG on national water issues. The Commission was responsible for undertaking a biennial assessment of each state's progress with implementing the NWI.

The role of the National Water Commission ceased in December 2014 and its water management functions are in the process of being transferred to other agencies. Assessment of progress in the implementation of the NWI will be transferred to the Productivity Commission along with monitoring the effectiveness of the implementation of the Murray–Darling Basin Plan and associated Basin State water resource plans

Murray-Darling Basin Cap Agreement

The Murrumbidgee catchment covers approximately 8% of the total area of the Murray-Darling Basin and is subject to agreements and statutes which cover water management within the Basin. The plan for the Murrumbidgee therefore has to be developed within the context of the Basin and existing commitments to water sharing.

In 1994 the Murray-Darling Basin Ministerial Council (MDBMC) undertook an assessment of water diversions across the Basin. This found that the level of diversions at that time was placing stress on both the environmental health of our river systems and the reliability of supply to water users; and that diversions were continuing to increase. In response, the MDBMC introduced a diversion limit – known as the Cap – in 1995.

Schedule F of the *Murray-Darling Basin Agreement* was introduced in 1996 and set the operating framework for the Cap. In NSW, the Cap is defined as the average yearly volume of water that would have been diverted under 1993/94 levels of development and management rules. The Cap does not apply to groundwater diversions.

Under the Agreement, plans are required to be developed to ensure consistency with the Cap. This means that the long-term average annual extraction limit (LTAAEL) for regulated and unregulated water sources must be equal to or less than the Cap. NSW has chosen to divide the Cap into unregulated and regulated components.

In regulated water sources, licences have been volume-based for a long time, and therefore require the metering of water extractions, which has provided a good basis for establishing the Cap. However, in unregulated water sources, irrigation licences were previously issued on the basis of the area of land to be irrigated, rather than a specific volume of water. The volumes of extractions from unregulated water sources have therefore not been monitored, which makes the establishment of a Cap problematic. In response, a volumetric conversion process was developed. As part of this process, irrigation licence holders were surveyed as to the area that they had irrigated over the six year period from 1993/94 and conversion rates developed to establish licensed entitlements and derive average levels of water use. There was no pattern of growth in irrigated areas over the survey period in any of the river systems, so the Cap is based on the information calculated as an average of the yearly assessments over the survey period.

The Cap for unregulated surface water in the Murrumbidgee is assessed and reported on at the Murrumbidgee valley scale and any growth management actions required will also be applied at this scale.

The Basin Plan

The Commonwealth *Water Act 2007* requires the Murray-Darling Basin Authority (MDBA) to develop a water management plan for the Murray-Darling Basin. The Basin Plan will be a legally enforceable document that provides for the integrated management of all the Basin's water resources. Some of the main functions of the Basin Plan will be to:

- set and enforce environmentally sustainable limits on the quantities of surface water and groundwater that may be taken from Basin water resources;
- set Basin-wide environmental objectives, and water quality and salinity objectives;
- develop efficient water trading regimes across the Basin;
- set requirements that must be met by state water resource plans; and
- improve water security for all uses of the Basin water resources.

The Basin Plan will provide the new foundation for managing the Basin's water resources in accordance with any rules and plan accreditation criteria established by the MDBA.

At the heart of the Basin Plan will be limits on the quantities of surface water and groundwater that can be taken from Basin water resources. These are known as 'sustainable diversion limits' (SDLs). As the SDLs come into effect, they will replace the current Cap on diversions in the Basin.

Further details can be found on the MDBA website www.mdba.gov.au in the Basin Plan section.

Natural Resource Commission targets

The Natural Resource Commission (NRC) was established in 2003 to provide the NSW Government with independent advice on natural resource management issues. To achieve this, the NRC has developed a Standard for Quality Natural Resource Management, along with 13 state-wide targets for natural resource management which have been embedded in the NSW State Plan. The Standard is designed to apply to natural resource management at all scales including at the state, regional, catchment and local level.

The NRC's Standard requires the use of the best available knowledge, appropriate information management systems, delivery of integrated outcomes, engagement of the community and regular monitoring, measuring, evaluation and reporting to specify how delivery of the targets are progressing. The NRC reviews water sharing plans against this standard and its associated targets. In 2013 the NRC reviewed 31 water sharing plans that were due to expire in 2014 and provided advice to the Minister for Primary Industries.

In 2012 the NRC reviewed the state-wide standard and targets, including monitoring, evaluation and reporting arrangements in NSW. They recommended five new state-wide targets that provide a sharper focus on the key long-term issues of concern to the Government and community and revised the monitoring, evaluation and reporting strategy to support the implementation of the new targets.

Catchment Action Plans

Catchment action plans are statutory, non-regulatory plans that were previously prepared by the state's catchment management authorities under the *Catchment Management Authorities Act 2003* (now repealed). In January 2014 the NSW Government established Local Land

Services (LLS) and transferred the functions of catchment management authorities into this new organisation to provide agricultural support, natural resource management and emergency management to rural communities through a single organisation. Riverina Local Land Services will be responsible for continuing the delivery of natural resource management programs within the Murrumbidgee valley, including catchment management plans.

NSW water planning policies and considerations

A number of policies and guidelines have been developed since commencement of the WMA 2000. These policies have arisen in response to specific water management issues that need to be considered during the development of water sharing plans. These policies directly influence the planning process and the formulation of water sharing rules.

Protecting pools, lagoons and lakes

Pools in NSW can provide an important source of water for licence holders, landholders and communities. Pools also have a key ecological function as a critical refuge and habitat for flora and fauna. For the purpose of this policy a pool refers to any lentic water bodies (standing water) within or associated with unregulated rivers in NSW, including water bodies that fall within the definition of a lake according to the Dictionary of the WMA 2000 (the exception is tidal pools and estuaries).

The policy document *Macro water sharing plans – the approach for unregulated rivers. Access and trading rules for pools* can be found on the DPI Water website www.water.nsw.gov.au. This document provides guidance for Interagency Regional Panels in setting water access and trading rules for pools that are covered by unregulated river water sharing plans.

The general approach is to establish a default access rule where no draw down is allowed below full pool capacity for the majority of pools. This default rule may be reviewed where it is justifiable and feasible to do so, to allow limited access to pools based on local hydrological, environmental and socio-economic considerations.

Default rules vary depending on the pool type. Generally the default rule for artificial pools is to adopt the existing licence conditions; however in some circumstances where this may not be appropriate, alternate rules will need to be developed. For natural pools, the default rule requires users to stop pumping when the pool is less than its full capacity (approximated by the greatest pool volume at which there is no visible flow leaving the pool).

The plan process does allow for more lenient access rules to be set if the default rules would significantly impact on current irrigation operations.

Managing surface water and groundwater connectivity

A key objective of the National Water Initiative is ‘recognition of the connectivity between surface and groundwater resources and connected systems managed as a single resource’. Most alluvial aquifers have a relatively high degree of connectivity with their associated surface water sources. Accordingly, most alluvial water sources are included in a water sharing plan that covers both surface water and its connected alluvial groundwater. Conversely, most porous rock, fractured rock and coastal sands aquifers are considered to have a lesser degree of connectivity and are included in groundwater-specific plans.

In the Basin, it is generally not practical for groundwater and surface water to be treated as one water source due to the MDBMC Cap, as the Cap does not apply to groundwater sources within the Basin.

Consistent with the state-wide approach, extraction from highly connected aquifer access licences that relate more closely to the regulated river will be managed annually, via AWDs,

whilst highly connected aquifer access licences that related more closely to unregulated water sources will be managed via unregulated river cease-to-pump rules.

The document *Macro water sharing plans – the approach for groundwater. A report to assist community consultation* provides further information about the principles used to develop water sharing rules for groundwater sources.

Protecting basic landholder rights

As defined under the WMA 2000, basic landholder rights (BLR) consist of domestic and stock rights, harvestable rights and native title rights. Water may be extracted under these rights without the need for a water access licence; although where groundwater is accessed under a domestic and stock right, the bore must still be approved by DPI Water.

The WMA 2000 requires that water sharing must protect BLR. The plan does this by identifying the requirements for domestic, stock and native title rights at the start of the plan and considering these requirements when designing the rules for licensed water extraction. The access rules for licensed water extractions do not apply to water extracted under BLR, thus affording priority to BLR users.

The requirements of harvestable rights have been inherently considered in the water sharing process, as access rules are based on river flows that result after harvestable rights extractions have occurred. There are currently no extractions for native title rights, however the plan allows for these rights should they be activated during the plan's ten year term.

The Murrumbidgee Unregulated water sharing plan provides an estimate of the water requirements for BLR within each water source, noting that these rights may increase during the life of the plan. The water sharing plan cannot limit or restrict these rights, but the WMA 2000 provides for restrictions on BLR through the development of mandatory guidelines.

Protecting town water supply access

Under the WMA 2000, extractions for town water supply are afforded a higher priority than extractions for commercial purposes such as irrigation. Water sharing plans recognise this priority by ensuring that a full share of water is allocated for annual town water supplies except where exceptional drought conditions prevent this. Local water utilities such as local councils are issued with local water utility access licences. The WMA 2000 allows for annual trade but not permanent trade of entitlement between local water utility access licences.

Any development of new water storages in the plan area must be undertaken within the bounds of the plan. The plan is not prescriptive in endorsing any particular option since economic considerations vary over time. Instead, the plan sets a framework within which development of future water supplies can occur in a sustainable manner.

Protecting Aboriginal values

Aboriginal people have a spiritual, customary and economic relationship with land and water that provides an important insight into natural resource management. The NSW Government established the Aboriginal Water Initiative in 2012 to facilitate effective engagement with Aboriginal communities in the water sharing process and ensure that measurable Aboriginal water outcomes are achieved. The Initiative aims to build Aboriginal peoples' capacity to participate as water users, protect their rights to water, maintain a healthy environment, and take full advantage of economic opportunities.

Water sharing plans recognise the importance of rivers and groundwater to Aboriginal culture. The plans will allow Aboriginal communities to apply for water access licences for cultural purposes such as manufacturing traditional artefacts, hunting, fishing, gathering, recreation and for cultural and ceremonial purposes. Aboriginal cultural licences can also be

used for drinking, food preparation, washing and watering domestic gardens. These cultural licences are limited to 10 ML/yr per application. Opportunity for granting licences for Aboriginal cultural purposes throughout the Murrumbidgee Unregulated catchment is included in the water sharing plan.

For further information refer to *Our Water Our Country. An information manual for Aboriginal people and communities about the water reform process* which is available from the DPI Water website www.water.nsw.gov.au

Water interception activities

Changes in land use activities can potentially result in the interception of significant quantities of surface runoff and throughflow. Activities that can impact on water quantity include increased farm dam capacity or the development of significant areas of new forestry plantations in a catchment. Under the National Water Initiative, significant interception activities should be accounted for within a plan's extraction limit.

Floodplain harvesting activities

Floodplain harvesting is the collection, extraction or impoundment of water flowing across floodplains, excluding the following types of water extraction:

- taking of water under any other type of water access licence that is not a floodplain harvesting access licence or an applicable water access licence exemption
- taking of water under a basic landholder right, including the harvesting of rainwater runoff
- runoff of irrigation water and stormwater which is subsequently captured in tailwater return systems or other means in accordance with licence conditions or methods which have been approved by DPI Water.

Floodplain harvesting works can generally be put into two categories:

- Purpose-built works specifically built to facilitate floodplain harvesting, including pumps, structures or other works that divert water into or from storages, supply channels, depressions or otherwise impound flows.
- Works built for multiple purposes that have the effect of facilitating floodplain harvesting, such as:
 - levees, conveying works and off-river storages constructed in billabongs or depressions
 - below-ground level channels from which the water is delivered into storages.

Floodplain flows can originate from local runoff that has not yet entered the main channel of a river, or from water that has overflowed from the main channel of a stream during a flood.

In unregulated river water sources, floodplain harvesting has generally already been recognised and licensed during the conversion of area based water licences to volume based licences. However, further volumetric entitlements, measurement and long-term limits for floodplain harvesting may be established in the future under the NSW Floodplain Harvesting Policy which is currently under development.

Instream dams

Farm dams currently require an access licence when:

- they are located on a third order (or greater) river, irrespective of capacity or purpose;
- they exceed the maximum harvestable right dam capacity for the property, which enables the capture of ten per cent of the mean annual run-off from the property, or

- they are on a permanent (spring fed) first or second order stream.

Unlicensed extraction from farm dams that doesn't match any of the above criteria may be permitted under "harvestable rights", a component of the basic landholder rights. The full activation of harvestable rights within the area of the plan is considered highly unlikely.

Water sharing plans cannot restrict the volume of water collected under harvestable rights² but can place restrictions on instream dams – dams that are located on streams of third order or higher. Under state-wide policy the construction of new instream dams is prohibited in those water sources in which high instream values have been identified.

Forestry expansion

The existing area of commercial forestry plantations within the Murrumbidgee catchment is 136,700 ha (less than two percent of the region). There are significant commercial forestry plantations within the Burrinjuck to Gogeldrie EMU which represent a significant interception activity. The area of commercial forestry plantations is projected to increase by 17,000 ha (12 percent) by 2030. This increase is expected to be concentrated in a small number of subcatchments where plantations currently exist. In these subcatchments the impact on runoff may be significant, however, the impact of the projected plantation development on average annual runoff for the entire region would be negligible CSIRO (2008).

Placing restrictions on forestry activities is beyond the scope of the water sharing plan. DPI Water recognises the potential impacts of forestry activities on catchment hydrology and is currently developing state-wide policy in relation to this issue.

² The maximum harvestable right dam capacity is calculated based on providing the ability to harvest 10% of the mean annual runoff from the landholder's property. It is determined using a calculator provided on the DPI Water website, with input parameters being property location and property size.

Developing the water sharing plan

DPI Water is responsible for implementing the WMA 2000, including developing water sharing plans for the state's water resources. DPI Water established several interagency panels to assist with the development of water planning policies and water sharing plans.

The Murrumbidgee Unregulated water sharing plan was prepared based on:

- indicative rules generated by a risk and values classification;
- the deliberations of the IRP; and
- feedback from stakeholders during targeted consultation and public exhibition.

This section describes the various panels and outlines the process of developing the Murrumbidgee Unregulated water sharing plan including the risks and values classification, refinement of the indicative rules based on panel deliberations, and targeted consultation and exhibition of the draft plan.

Role of the panels

State Interagency Panel

The State Interagency Panel has overall responsibility for the strategic direction of water planning in NSW, to ensure that adequate resources are available from each agency and that the varying policy and statutory requirements of the relevant NSW Government agencies are met. The State Interagency Panel also has the role of making water sharing decisions in cases where regional panels cannot reach agreement or where the issue has state-wide significance.

The State Interagency Panel is chaired by DPI Water and comprises representatives from DPI Water, OEH, Local Land Services (formerly catchment management authorities), and agriculture, fisheries and aquaculture specialists from the NSW Department of Primary Industries (DPI). DPI Water is responsible for the overall project management.

State Groundwater Panel

The State Groundwater Panel was established to oversee the development of policy for the macro water sharing planning process for groundwater. The Panel has members from NSW DPI Water, OEH, and DPI. Local Land Services are also represented by an inland and coastal representative.

The State Groundwater Panel is a subcommittee of the State Interagency Panel. The Panel provides a senior level forum for discussing and resolving a wide range of water planning and policy issues specific to groundwater. In particular, the State Groundwater Panel developed state-wide distance criteria which the regional panels used as a starting point when considering distance rules for groundwater sources.

Interagency Regional Panels

Interagency Regional Panels (IRPs) were established to develop water sharing plans. Regional panels consist of two representatives from DPI (one from DPI Water and another representing agricultural and fisheries interests), and one representative from OEH. A representative from Local Land Services attends meetings as an observer to provide advice on consultation issues and other matters within their areas of expertise.

Appendix 3 lists the names of the Murrumbidgee Regional Panel representatives and their areas of expertise, and lists their colleagues who they had access to for specific technical and scientific information.

The key responsibilities of the IRP were to:

- ensure water sharing rules are consistent with state policy;
- review the water management units provided by DPI Water;
- review economic, social and environmental values and undertake risk and value assessments to classify each unregulated water source;
- review existing and generic water sharing rules as to their applicability;
- make recommendations on water access and dealing rules for each water source;
- assist with consultation on the proposed rules; and
- review submissions from targeted consultation and public exhibition, and make changes where necessary to the water sharing rules.

The IRP used local knowledge and expertise in developing and recommending the water sharing rules through a consensus decision-making approach.

Consultation to inform rule development

The draft rules underwent targeted consultation with specific interest groups and water users where significant changes in management were proposed before the plan was drafted. Formal public exhibition of the draft plan ensured wider public consultation.

The former Catchment Management Authorities assisted with the public consultation process, to ensure that all stakeholders and interested parties had an opportunity to examine and comment on the proposed water sharing rules. In particular, stakeholders were encouraged to provide:

- local knowledge and expertise – for example, there may be other natural or socio-economic values that have not yet been considered by the IRP;
- feedback on the practical elements of the proposed water sharing rules - to make certain they are easily implemented by the licence holders;
- confirmation that there are no unintended outcomes from the plan – it is essential that this be given due consideration before the plan is finalised; and
- specific comments on the Minister's notes included in the draft plan.

Targeted consultation on the draft rules

Targeted consultation refers to informal consultation held with key stakeholders to test the suitability of the proposed water sharing rules and provide feedback on potential impacts of the rules. Targeted consultation for the draft Murrumbidgee Unregulated water sharing plan occurred between August and October 2010. The objectives of this consultation were:

- to provide background for key stakeholders as to why the plans were being developed, how they were developed, what rules were proposed in the various areas and how stakeholders could provide feedback; and
- to provide a 'first opportunity' to informally consult and to test the suitability of the proposed water sources and management zones, flow reference points and access and trading rules where significant changes were proposed from current management.

The IRP reviewed all the submissions and the matters raised at the targeted consultation meetings and consequently made changes to the initial water sharing rules.

During the planning process the following organisations were also consulted to gather additional information to assist rule development:

- ActewAGL;

- ACT Environment and Sustainable Development;
- Snowy Scientific Committee;
- Riverina Water County Council; and
- Goldenfields Water County Council.

Targeted consultation for replacement plans

Public submissions regarding the Adelong, Tarcutta and Upper Billabong water sharing plans were called for in 2012. These submissions and additional information were collated and reviewed in 2013. A report was submitted to the Minister recommending these plans be replaced.

Key stakeholders were informed of the proposed changes to the rules in these water sources through information sessions held in Adelong, Tarcutta and Holbrook.

- Adelong Water Source – 8 October 2014 in Adelong. This meeting was attended by eight licence holders. There was discussion around changes to the town water supply (no longer extracted from Adelong Creek), and cease-to-pump rules. Stakeholders were supportive of changes to the water sharing plan and the approach being taken by DPI Water.
- Tarcutta – 8 October 2014 in Tarcutta. Ten licence holders attended the meeting. Discussions focussed on changes to the flow reference points for some of the management zones and minor local issues (unrelated to the plan). Stakeholders were supportive of changes to the water sharing plan and the approach being taken by DPI Water.
- Upper Billabong – 7 October 2014 in Holbrook (no attendees).

Public exhibition of the draft water sharing plan

Public exhibition is the formal exhibition of a draft water sharing plan where the Minister invites submissions on the draft plan and in particular will seek comment on a range of key issues. Public exhibition of the draft Murrumbidgee Unregulated water sharing plan was held from 10 October 2011 to the 9 December 2011, with ten public meetings held across the catchment (Table 7).

Table 7: Public meetings held in the Murrumbidgee catchment

Date	Location
24 October 2011	Hay Services Club
25 October 2011	Leeton Soldiers Club
26 October 2011	Wagga Wagga Commercial Club
27 October 2011	Culcairn Bowling Club
31 October 2011	Yass Soldiers Club
1 November 2011	Palerang Council, Bungendore
2 November 2011	Alpine Hotel, Cooma
3 November 2011	Tumut Bowling and Recreation Club

The objectives of this consultation were:

- to provide background to stakeholders as to why the water sharing plan was being developed, how it has been developed to date, what rules were proposed in the various areas and how stakeholders could provide feedback;
- to formally consult with a broad range of stakeholders to explain the proposed water sharing rules and how they will be implemented; and
- to seek feedback in writing from stakeholders and the general community about the proposed water sharing rules.

Sixty-nine written submissions were received from a wide range of stakeholders. The IRP reviewed all the submissions and consequently made changes to the proposed water sharing rules. During this review process, if updated data became available, it was also incorporated into the planning process.

No public exhibition period was held for the merging of the three replacement water sources. This was because the plans had already been subject to public exhibition when they were first developed and major changes to water sharing rules were not proposed. As indicated above, public consultation regarding the proposed changes occurred through information sessions held in each catchment during October 2014.

Water sharing rules for unregulated surface water sources

Water source classification

In developing water sharing plans for unregulated rivers, DPI Water classifies each water source based on the risks and values of water extraction.

Specifically the classification process involves assessing:

- instream values (such as threatened fish species) and the risk to these values posed by existing or increased extraction;
- hydrologic stress, based on the demands for licensed extraction relative to river flows;
- the risk to instream values posed by extractions;
- extraction value, a qualitative assessment of the economic value of the agriculture which relies on the water licensed for extraction;
- the economic dependence of the local community on activities requiring licensed water extraction; and
- the sensitivity of estuaries to the removal of freshwater inflows.

For the Murrumbidgee Unregulated water sharing plan, each water source was classified according to these values and risks. The IRP then reviewed these classifications against a range of reference material and data including irrigation data, hydrologic data, aquatic ecology information, fisheries data, and threatened species data. Extraction patterns by local water utilities were also examined. A list of data and reference material that was used by the IRP can be found in Appendix 4.

The final classifications were used to generate indicative access and trade rules which provided the basis for deliberations and the development of draft water sharing rules.

Access rules for unregulated water sources

Upon commencement of the Murrumbidgee Unregulated water sharing plan in 2012, all surface water licences in all unregulated water sources became subject to access (cease-to-pump) rules (excluding licences listed in Schedule 5 of the plan). These rules vary depending on where a licence is located within the plan area. This information can be found on individual rule summary sheets available on DPI Water's website www.water.nsw.gov.au.

Under the macro planning process, generic access rules are determined by balancing the risk to instream values (a product of instream value and hydrologic stress) and the community dependence on extraction. It is important to note that the macro approach was used as an indicative tool to develop initial classifications. While these classifications guided the water sharing rules, a major role of the IRP was to use the local knowledge of panel members to check whether these classifications were realistic. For example the IRP considered:

- existing local water sharing rules, to determine whether they achieved the required level of environmental protection and provided for basic rights;
- local studies or information from regional staff in areas such as irrigation (DPI) or aquatic ecology (DPI Water); and
- extraction patterns by local water and major utilities.

In some instances, indicative rules were further refined if site specific information was available.

In some water sources there is no information on river flow and no hydrologic connection to other water sources or within the water source. In these water sources using the macro

approach is inappropriate. A different approach was taken for these water sources, which is described below in the section on “Disconnected Water Sources”.

The Murrumbidgee IRP recommended draft access and trading rules for 39 unregulated water sources based on either the macro classification approach and indicative rules, or on the disconnected water sources approach.

Minimal changes were made to the access and trading rules for the Adelong, Tarcutta and Upper Billabong water sources as these water sources had been through their own process during the development of the 2004 water sharing plan.

Access rules for rivers and creeks

The macro approach results in a set of indicative access rules otherwise known as cease-to-pump (CTP) rules. There are generally four rule levels that can be applied depending on the instream value and community dependence on extraction (Table 8).

Table 8: Indicative access rules for rivers and creeks under the macro approach

Rule level	Indicative cease-to-pump rule	Indicative environmental rule	Instream value	Community dependence
1	No pumping unless flows exceed a specified level at the reference point	Consider commence-to-pump rule	High	Low
2	No pumping unless there is a visible flow at the reference point	Consider commence-to-pump rule	↑	↓
3	No pumping if it draws down the pool	Consider commence-to-pump rule		
4	Exception to no drawing down pools rule for example allow pool drawdown to a specified level		Low	High

Access rules for pools, lagoons and lakes

The indicative rule for all instream natural pools where visible flow at the pump site is the only access rule in the water source or management zone is “no drawdown below full capacity”. For water sources where the indicative access rule is set at a reference point other than the pump site (for example a road bridge, or gauging station), the no drawdown rule for instream pools described above does not apply, and the access rule for the water source or management zone does apply.

For natural pools that are not within a stream but have licences on them, the access rule for the Murrumbidgee Unregulated plan is to cease to pump when the level in the pool has been drawn down to 80% of its full capacity. This rule was adopted by the Regional Panel in recognition of the fact that these off-stream water bodies provide the only water available for much of the time in the water sources where this rule applies. All off-stream pools with no licences on them are fully protected from extraction as no licences can be transferred onto them under the water sharing plan trading rules.

For artificial pools created by structures covered by a water supply work approval existing licence conditions will continue. Where there are no existing conditions the indicative rule constraints will only apply to the natural portion of the pool, not to the augmented portion.

Water sharing plans contain amendment provisions to allow for changes to be made to access and trading rules for a particular pool or category of pool should new information be gained through environmental and/or socio-economic studies relating to pools in a plan area.

Dealings (trading) rules in unregulated water sources

Trading rules under the macro planning process for inland catchments are guided by the following principles:

- Where instream values are considered high, trades are either not permitted or only allowed into high flows.
- Where a water source is under high hydrologic stress no trades are permitted into the water source.
- Trades into downstream water sources are permitted regardless of stress or instream value, as long as the water sources have a direct hydrologic connection.
- Trades through a regulated river are not permitted, for example a licence cannot be traded from an unregulated water source upstream of the regulated reach to a water source downstream of the regulated reach.
- Trading within water sources is generally permitted, however in some areas trading may be restricted to protect high value areas or to limit demand in areas where competition for water is already high.

As a result of these principles, trades are not permitted into many unregulated water sources across the plan area. High instream value water sources are protected by prohibiting trades or limiting trades into only higher volume flows. Trades are allowed into some water sources with lower value in order to encourage the movement of extraction from high to lower environmental value areas. Trades between water sources have been permitted in some circumstances where there is a direct hydrologic connection but only within individual EMUs.

Refining the indicative rules

Guided by the indicative access and trade rules, the IRP used local knowledge and expertise to develop the access and trade rules for the draft water sharing plan. Indicative rules were revised based on site specific considerations such as:

- the availability of infrastructure (for example river gauges)
- the availability of management systems (for example ability to manage the rules)
- existing management rules (for example existing licence conditions or Water Users Association rostering rules which distribute low flow access amongst licensed users)
- whether flow regimes within different areas of a water source required differing management rules for those sub-areas.

In water sources where the existing cease-to-pump rule under the *Water Act 1912* was more stringent than the indicative rule, the existing access rule was generally adopted. It was recognised that some licences had been issued under the *Water Act 1912* on the basis that they access higher flows, and no change to current operations should mean no adverse social or economic impact. In these circumstances the IRP acknowledged that many of the rules had been negotiated by water users or stipulated as outcomes of Rural Land Board hearings. These rules had been in place for a period of time and seemed to be adequately protecting values while providing certainty for water users.

Table 9 outlines the changes made by the IRP to the initial access and trading rules based on local knowledge and consultation.

Table 9: Refinements to the water sharing rules by the IRP

Water source	Change to water sharing rules	Justification
Adjungbilly / Bombowlee / Brungle	Split into 5 management zones as there are 5 separate catchments that do not merge in the water source. CTP changed from 'visible flow at the end of the water source' to 90 th ile in Bombowlee Management Zone and 95 th ile in Adjungbilly Management Zone. Trading changed from 'trade in allowed' to 'no net gain trades' in Bombowlee and Brungle Management Zones and 'no trade in' in Killimicat and Oak Creek Management Zones.	Existing access arrangements under <i>Water Act 1912</i> are already linked to a gauge which is more rigorous than visible flow. 90 th ile set for Bombowlee as decreased stream flow from plantation forestry. Natural stream flow has decreased due to plantation forestry, and there is high hydrologic stress in Killimicat Management Zone.
Billabung	CTP changed from 90 th ile to 0.6 m at the Billabung Creek at Nangus Road water quality station (41010705)	No suitable reference point at which to measure 90 th ile. Existing access condition at a site easily accessible by licence holders Compliance more rigorous than visible flow.
Bredbo	CTP changed from 90 th ile to 'no visible flow' in the Bredbo River at the Monaro Highway Road Bridge. Trading changed from 'no net gain' to 'no trade in'.	No other suitable reference point and 90 th ile was only 0.03 ML/day. Already has a high hydrological stress, to reduce this stress only allow trade out.
Bredbo, Murrumbidgee Central (Burrinjuck to Gogeldrie)	Allow drawdown of 50% by volume of an excavation for a limited number of licences and place individual licences on a schedule	Allows some access in areas where there is significant subsurface flow, No appropriate flow reference points. Number of licence holders and volumes of water are minimal.
Burkes/ Bullenbung	CTP changed from 90 th ile to 'no visible flow'	No gauge at which to measure 90 th ile
Gilmore/Sandy	CTP changed from 'visible flow' to 95 th ile. Trading changed from 'no net gain' trades to 'trade into high flows'	Existing access arrangements under the <i>Water Act 1912</i> . Already linked to a gauge which is more rigorous than visible flow. Trade in allowed due to high economic dependency but limited to high flows only due to high hydrologic stress in lower flows.
Goobarragandra	CTP changed from 'no visible flow' to '97 th ile'	Wild and Scenic River, requires more rigorous protection than visible flow,
Goodradigbee	CTP changed from 'no visible flow' to '97 th ile' Trading changed from 'no trade in' to 'trade in limited to high flows only'. An amending clause is included in the plan that allows the CTP to vary once more information is known about the SMRIF (Snowy Montane Rivers Increased Flows).	Existing access arrangements under the <i>Water Act 1912</i> ; Wild and Scenic River so requires more protection than visible flow Trade in allowed as there is a medium dependence on extraction and low hydrologic stress. Trade is limited within the EMU so this provides trade opportunities. Amendment clause allows environmental flows to be protected in future if required.
Hillas	CTP changed from 'visible flow' to 90 th ile. Trading changed from 'no net gain trades' to 'trade in limited to high flows'.	Existing access arrangements under the <i>Water Act 1912</i> already linked to a gauge which is more rigorous than visible flow. Trades in allowed due to high economic dependency.
Houlaghans	CTP changed from 90 th ile to 'no visible flow'.	No suitable reference point, and river only flows 10% of the time.

Water source	Change to water sharing rules	Justification
Jugiong	Water Source split into three management zones in order to have a suitable flow reference point in each management zone. CTP changed from 95 th %ile to 'visible flow'.	No suitable reference gauge at which to measure 95 th %ile.
Kyeamba	CTP changed from 90 th %ile to 1ML/day.	Volume at 90 th %ile is 0 ML/day, expected that 1ML/day is equivalent to visible flow at the end of the water source.
Lower Billabong	Water source split into 2 management zones to reduce hydrologic stress in the low flows of Billabong Creek between January and June. For Lower Billabong Creek Management Zone CTP changed from visible flow to: 80 ML/day on a rising river and 49 ML/day on a falling river (1 January to 30 June). 66 ML/day on a rising river and 49 ML/day on a falling river (1 July to 31 December), For Nowranie Creek Management Zone CTP changed to 66 ML/day on a rising river and 60 ML/day on a falling river	An appropriate gauge exists in the stream. These rules are a continuation of existing access arrangements under the <i>Water Act 1912</i> which provide greater protection to the environment than visible flow and were agreed to by licence holders.
Middle Billabong	Water source split into 2 management zones as the downstream of Culcairn management zone has more extraction and potentially impacts on Lower Billabong water source. For Upstream of Culcairn Management Zone CTP changed from 95 th %ile to 80 th %ile. For downstream of Culcairn Management Zone CTP changed from 95 th %ile to: 80 ML/d on a rising river and 49 ML/d on a falling river (1 January to 30 June). 66 ML/d on a rising river and 49 ML/d on a falling river (1 July to 31 December).	Higher CTP to protect the hydrologically stressed downstream management zone and Lower Billabong Water Source. Continuation of existing access arrangements under the <i>Water Act 1912</i> .
Molonglo	CTP changed from 95 th %ile to 80 th %ile. Trading changed from 'trade in allowed' to 'no net gain trades'.	High domestic use of water downstream of the gauge due to rural residential development. It was thought that a flow of 80 th %ile at the gauge would be required to achieve 95 th %ile at end of water source. Data used to determine hydrologic stress is for NSW only so is likely to underestimate hydrologic stress. Secondly, waters in the Molonglo River are reserved for the ACT under the Seat of Government Act 1908.
Mountain	CTP changed from 95 th %ile to 80 th %ile. Trading changed from 'trade in allowed' to 'no net gain trades'.	95 th %ile is 0 ML/d. Setting CTP at 80 th %ile likely to maintain a visible flow to the end of the water source. To protect Lower Billabong Water Source.
Murrumbidgee I	CTP changed from 90 th %ile to 95 th %ile.	Corresponds to base passing flows from Tantangara and continuation of existing arrangements under the <i>Water Act 1912</i> .
Murrumbidgee II	CTP changed from 90 th %ile to 95 th %ile.	Low flows are more reliable due to Tantangara Reservoir and continuation of existing access arrangements under the <i>Water Act 1912</i> .

Water source	Change to water sharing rules	Justification
Murrumbidgee III	CTP changed from 90 th ile to 95 th ile. Trading from 'no trades in' to 'no trades onto the tributaries' and 'limited trade into moderate to high flows' on the Murrumbidgee River	Significant tributary inflows below gauge. To allow the opportunity for some trading in the EMU as this is one of the least hydrologically stressed water sources.
Murrumbidgee (Gogeldrie to Waldaira), Murrumbidgee Central (Burrinjuck to Gogeldrie), Murrumbidgee Western	Add an amendment clause to the plan that says extraction cannot occur for 30 days after the commencement of a provided environmental water event.	Provides protection to environmental water but allows negotiations to occur where mutual benefits could be achieved for both parties through negotiation.
Muttama	CTP changed from 90 th ile to 'visible flow.'	No suitable gauge to measure 90 th ile.
Numeralla East	CTP changed from 95 th ile to 87 th ile.	95 th ile is 0 ML/day. 87 th ile allows some access by users and protects low flows.
Numeralla West	Water source split into two management zones to reflect inflows that occur from the sewerage treatment plant. CTP changed from 90 th ile to 80 th ile in the Cooma Management Zone. CTP changed from 90 th ile to 'visible flow' in the Bunyan Creek Management Zone.	90 th ile is 0 ML/day. 80 th ile allows some access by users and protects low flows. Increased flows downstream of Cooma due to sewerage treatment plant
Tantangara	CTP changed from 95 th ile to 'visible flow'. Trading changed from 'trade in allowed' to 'no trade in'.	No suitable gauge to measure 95 th ile Water source is predominantly National Park or within Snowy Hydro Limited's area of operation. It is also upstream of Murrumbidgee I Water Source where the indicative trading rules are for no trade into or upstream of the water source.
Ten Mile	CTP changed from 95 th ile to 80 th ile. Trading changed from 'trade in allowed' to 'no net gain trades'.	95 th ile is 0 ML. 80 th ile is likely to maintain visible flow to end of water source. To protect Lower Billabong Water Source.
Upper Tumut	CTP changed from 95 th ile to 'visible flow'.	No suitable gauge to measure 95 th ile.
Yarra Yarra	CTP changed from 95 th ile to 'visible flow'. Trading changed from 'trade in allowed' to 'no net gain trades'.	No suitable gauge to measure 95 th ile. Existing access arrangements under the <i>Water Act 1912</i> To protect Lower Billabong Water Source
Yass Lower	CTP changed from 80 th ile to 'visible flow'. Trading changed from no net gains to no trades in.	No suitable gauge to measure 80 th ile. Existing access arrangements under the <i>Water Act 1912</i> Water source has high hydrologic stress, aim to reduce entitlement
Yass Upper	Water source divided into two management zones based on inflows that occur below Macks Reef Road gauge. CTP changed from 80 th ile to 24 th ile. Trading changed from no net gains to no trades in	Flow only occurs 75% of time, continuation of existing access arrangements under the <i>Water Act 1912</i> . Flows at 24 th ile likely to achieve visible flow to end of water source. Water source has high hydrologic stress, aim to reduce entitlement

Refining the access rules in replacement water sources

Changes to the access rules in the Adelong, Tarcutta and Upper Billabong Creek water sources have been limited to:

- standardising clauses to make them consistent with the latest water sharing plans and legislative framework;
- incorporating policy developments since 2004;
- reviewing flow reference points; and
- reviewing daily flow sharing provisions.

TDELS

The Murrumbidgee Unregulated water sharing plan does not establish Total Daily Extraction Limits (TDELS), but allows these to be established through an amendment provision if necessary. TDELS that were established in the original plans for the Adelong, Tarcutta and Upper Billabong water sources have therefore not been carried forward into the Murrumbidgee Unregulated plan. Mostly this is due to the lack of infrastructure which limits the ability to effectively manage these daily limits. An amendment provision is included to allow these to be reinstated in the future if required.

Policy changes

The Adelong water sharing plan previously allowed for applications for in-river dams. DPI Water's current policy is to allow applications for in-river dams except in those water sources which have been identified as having a high instream value. When a risk and value assessment was completed for Adelong Creek it was classified as having high instream value and there for applications for new in-river dams will no longer be accepted in this water source.

None of the 2004 plans included specific access and trading rules for pools. DPI Water has now developed a policy for accessing water from pools in unregulated systems which has been adopted in the Murrumbidgee Unregulated water sharing plan. The policy restricts extraction from pools below a specified level (80% of full capacity in the Murrumbidgee Unregulated plan).

Applications for specific purpose licences

Each of the three plans previously allowed for the granting of new domestic and stock access licences. Under the Murrumbidgee Unregulated water sharing plan applications for domestic licences are permitted, but applications for stock licences will not be accepted. To achieve consistency with all other Murrumbidgee unregulated water sources the provisions allowing applications for stock licences in the Adelong, Tarcutta and Upper Billabong water sources have not been carried over into the new plan.

The previous Tarcutta and Upper Billabong water sharing plans permitted the granting of Aboriginal Cultural access licences provided the TDELS assigned didn't exceed a specified amount of each flow class. Current policy is to allow the granting of these licences up to 10 ML per year each and this policy has been applied to all replacement water sources to make them consistent with the other unregulated water sources.

The previous Tarcutta and Adelong water sharing plans allowed applications for Unregulated River (Research) licences provided the TDEL assigned didn't exceed a specified amount of each flow class. The current water sharing plans do not specifically provide for these licences and therefore this provision has been removed.

Flow reference points and cease-to-pump

The major revision is a change in the flow reference point for most of the water sources. During the development of the earliest water sharing plans the policy was to set access rules based on the flow at the end of the water source. In many cases however, there was no gauge at the end of a water source. For the rules to be properly implemented flows had to be correlated back to a functioning gauge or other reference point so that licence holders could know when they were able to access water.

Replacement of the original plans allows the flow reference point to be revised to better reflect licence holder's current conditions and make the access rules easier to implement and monitor. In all cases the new flow reference point and CTP have been correlated to the existing conditions so that there is no change to the level of access. Further information on these changes can be found on the report card for each water source.

Adelong Creek

In Adelong Creek water source the CTP was revised from 15 ML/d at the end of the water source to 12 ML/d at the Batlow Road gauge (410061). This is based on a correlation between the two points which was prepared at the time of development of the 2004 plan.

Tarcutta Creek

In Borambola Management Zone the CTP was based on the end of system flow (13 ML/d). This has now been revised to the equivalent flow (12 ML/d) at the Borambola gauge (410047).

In Westbrook Management Zone the flow reference point was changed to Westbrook gauge (410058) where the flow is actually measured (rather than correlated to Borambola gauge).

In Umbango Management Zone the flow reference point has also been changed to the Westbrook gauge (410058). The CTP for this management zone was previously based on a staff gauge within the zone which is less practical for licence holders to access.

Upper Billabong Creek

In Billabong Creek Management Zone the CTP was based on the end of system flow (1.84 ML/d). This has now been revised to 2 ML/d at the Aberfeldy gauge (410097) which is easier for licence holders to access. The flow has been rounded to 2 ML to better reflect the accuracy of gauging that can be achieved.

In Billabong Headwater Management Zone the CTP and flow reference point will also be 2ML at Aberfeldy gauge (410097) to improve implementation of the access rules. Previously the CTP was based on an amount of flow coming through a pipe, while higher flow classes were based on flow at the end of the system.

Disconnected water sources

Some water sources have no hydrologic data. These water sources are made up of off river pools, flood runners and effluent streams that are usually disconnected to other water bodies. It was not possible to apply the macro approach to these water sources. Instead access rules were based on the access rules for pools, lagoons and lakes described earlier and trading is prohibited because there is a lack of hydrologic connection. The rules applied are shown in Table 10 below.

Table 10: Access and trading rules applied to disconnected water sources

Water Sources	Rules	Justification
Lake George Lower Billabong Anabranh Murrumbidgee Central (Burrinjuck to Gogeldrie) Murrumbidgee (Balranald to Weimby) Murrumbidgee (Gogeldrie to Waldaira), Murrumbidgee North Murrumbidgee Western Upper Wangamong	<p>Access Rules:</p> <p>Visible flow at the pump site</p> <p>No drawdown of instream pools</p> <p>Drawdown to 80% of full capacity for all natural off river pools (those with no works) and pumping of additional capacity created by licensed works allowed down to 80% of capacity of the natural pool extent</p>	<p>The streams within these catchments are disconnected.</p> <p>There are no suitable gauges or other reference points at which to measure flow.</p> <p>All lagoons without licences are protected from any extraction by no trade in.</p> <p>Allows some access to the lagoons with licences.</p> <p>Allows greater access to users who have increased the lagoons storage capacity.</p>
	<p>Trading Rules:</p> <p>No trades are permitted into the water source.</p> <p>Trade is permitted within the water source but not onto off river pools.</p>	<p>There is no hydrologic connection between this water source and any other unregulated water sources.</p> <p>There is no hydrologic connection to the off river pools within the water source.</p>

Exemptions to access rules

Access to very low flow

Activities that are considered critical to human needs or animal health requirements are permitted to continue to access water when stream flows are in the very low flow range (i.e. below the CTP). Such activities include:

- domestic supply;
- stock supply for first 5 years of the plan, after which the CTP rule will apply;
- town water supply, until major augmentation of the schemes infrastructure occurs;
- fruit washing;
- cleaning of dairy plant and processing equipment for the purpose of hygiene;
- poultry washing and misting; and
- cleaning of enclosures used for intensive animal production for the purposes of hygiene.

Basic landholder rights

The water sharing plan does not impose access rules on basic landholder rights. These users are exempt from the CTP.

Managing extraction in unregulated water sources

Long Term Average Annual Extraction Limit

There are four extraction management units (EMUs) within the Murrumbidgee Unregulated water sharing plan (refer to Table 1). Each EMU sets its own long term average annual extraction limit (LTAAEL) to which extractions will be managed.

For surface water in inland NSW, the LTAAEL is based on the Murray-Darling Basin Cap which was introduced in 1995 to halt growth in extractions across the basin. The LTAAEL for the Murrumbidgee EMUs is equal to the total of the estimated annual extraction of water averaged over the period from July 1993 to June 1999; plus an estimate of annual extraction of water under domestic and stock rights and native title rights, at the commencement of the Murrumbidgee Unregulated water sharing plan.

LTAAEL in the replacement water sources

The Upper Billabong Water Source is part of the Unregulated Billabong EMU while the Tarcutta Creek and Adelong Creek water sources are part of the Unregulated Murrumbidgee below Burrinjuck Dam to Gogeldrie EMU. The entitlements for these water sources were included in the LTAAEL for the relevant EMUs when the plan commenced in 2012 and therefore no changes to the LTAAEL are required now that these water sources are being managed through this plan.

Growth in use

To protect the water set aside for the environment and the supply to existing users, it is important to control any growth in water used over time that is above the limit specified in the plan i.e. growth in extractions above the LTAAEL. The IRP had some scope in determining how growth was assessed for each EMU including the period of time over which extractions are averaged, and the level of tolerance permitted.

For the Murrumbidgee EMUs, a growth-in-use response will be triggered if the average annual usage over three years exceeds the LTAAEL by more than 5%.

This decision was based on the knowledge that rivers and streams in the western slopes and plains experience high variability in flows which results in high variability in extraction.

Available water determinations

Available water determinations (AWDs) are primarily used to credit water into a licence water allocation account. Specific purpose access licences such as domestic and stock, will generally receive 100% of their share component, although in dry years, daily access rules may limit extraction so that the full annual entitlement cannot be realised.

AWDs are also used to manage growth in extractions above the LTAAEL, that is if growth occurs then the maximum AWD will be reduced to less than 1 ML per unit share in order to manage growth.

The AWD for unregulated river access licences will be 1 ML per unit share, unless a growth-in-use response is required. However for the first year of the plan, a one-off announcement of 2 ML per unit share will be made to allow the operation of three year accounting rules described below.

Carryover and water accounts

A water allocation account will be established for each water access licence. Water is credited to the account when an AWD is made, and debited when water is extracted. A licence holder's account is not permitted to go into debit.

Unregulated rivers have enormous variation in annual flows between years. It is therefore important to allow this variability to be reflected in accounting practices. Unregulated river access licence account management will operate under three year accounting rules. Available water determinations combined with the carryover allowance will enable licence holders to use up to twice their water allocation in a year provided that over a consecutive three year period they do not exceed the sum of their water allocations for those three years.

For the first three years of the plan, this maximum volume that may be taken may not exceed a volume equal to three times the access licence share component (where this is expressed in megalitres), or 3 ML per unit share (where the share component is expressed in unit shares). This restriction in the first three years is due to the allocation of 200% (where share component is expressed as a volume) or 2 ML per unit share (where share component is expressed in unit shares), made in the first year of the plan to allow the operation of these accounting rules from year one of the plan.

The maximum amount of unused water allocation that can be carried over from one water year to the next in unregulated river access licence accounts will be 100% of the share component (where this is expressed in megalitres), or 1 ML per unit share (where share component is expressed in unit shares).

Example of unregulated river access licence three year accounting rules

An example of three year accounting for an unregulated river access licence holder with a share component of 50 shares is shown in Table 11.

Table 11: Example of unregulated river access licence accounting rules

Year	Account balance (ML at start of year)	AWD (ML/unit share)	Usage (ML)	Account balance (ML at end of year)	Carryover (ML)
1	0	2	0	100	50*
2	50	1	50	50	50
3	50	1	100**	0	0
4	0	1	0***	50	50

* Only 50 ML can be carried over as carryover is limited to 1 ML/unit share. The remaining 50 ML is forfeited.

** 100 ML is also the maximum that can be extracted in this year, that is, twice the allocation for the year which is 2x 50 ML = 100 ML.

*** Although with the AWD there is 50 ML in the account, no water is available for extraction as the maximum extraction over three years is the sum of AWDs in those 3 years which in this example is 150 ML and this was extracted in year 2 and 3 so no extraction can occur in year 4.

Water sharing rules for alluvial groundwater sources

In preparing rules for the alluvial groundwater sources in the Murrumbidgee Unregulated Plan, the IRP focused on:

- dealing rules - which control the trade of water (both permanent transfer of access licence entitlements and temporary assignment of water allocation between access licences, the change of water sources and the location for extraction); and
- extraction limits – which set the total volume of water that can be extracted on a long-term average annual basis from the water source.

Other management rules that were considered in the development of the plan include:

- assessing growth – how growth in diversions are assessed;
- managing growth – rules for available water determinations;
- rules for granting new licences;
- rules for granting works approvals – what types of setback conditions are required; and
- rules for the protection of a specific environmental asset.

These rules form the basis of mandatory conditions on water access licences and approvals.

Defining connectivity

For the purposes of developing plans for inland aquifer systems, DPI Water has defined a highly connected system as a system in which “70% or more of the groundwater extraction volume is derived from stream flow within a single irrigation season”. This is a simplified version of, but still reasonably consistent with, the key findings and conclusions circulated for discussion amongst state jurisdictions by the former Murray Darling Basin Commission in their report Evaluation of the connectivity between surface water and groundwater in the Murray-Darling Basin (MDBC 2008).

There are six alluvial groundwater sources in the plan area. Using the definition above, only the Jugiong Alluvial Management Zone within the Gundagai Alluvial Groundwater Source is considered to be ‘highly connected’. All other management zones and groundwater sources are considered ‘less highly connected’.

To recognise the connection between the regulated river and the Jugiong Alluvial Management Zone a component of the AWD for the Jugiong Alluvial Management Zone will be linked to the Murrumbidgee Regulated River AWD for high security access licences. See section on Available Water Determination below for more details.

Hydrologic modelling

A more detailed understanding of stream hydrology, the impact of extractions, the operation of the regulated river, and the interactions between the regulated, unregulated and groundwater systems, is needed to address some of the more complex water sharing issues. Hydrologic modelling provides the basis for a better understanding of these processes and interactions.

Hydrologic modelling refers to the use of a numerical computer tool to simulate river flows, dam storage, water extraction, losses and operation, irrigation demands and water sharing plan rules.

Modelling was used to assist the decision making process to determine recharge into the Mid Murrumbidgee and Wagga Wagga Alluvial Groundwater Sources.

Groundwater models developed by DPI Water use the world's most accepted groundwater modelling software, MODFLOW, developed by the United States Geological Survey.

The conceptual model associated with the groundwater model for an identified area captures all of the essential hydrological components active in that area. For example, a typical groundwater model will consist of the following flow components: surface recharge, evapotranspiration, river leakage to and from the groundwater system, horizontal recharge from, and discharge to, bounding areas, vertical interchange of groundwater between major hydrogeological units, and groundwater pumping volumes.

Recharge to groundwater systems arises predominantly from downward infiltration associated with processes occurring at the ground surface, such as rainfall, evapotranspiration, floods, irrigation and river leakage. Hence, all of these components are specifically addressed in the creation of groundwater models. Generally, DPI Water models are developed with a monthly data frequency. This means that monthly values of rainfall, evaporation, river height and irrigation usage need to be incorporated together with historical flood information. In addition to temporal variation of these processes over the historical period of the model (which may, for example, be 30 years), models also address their spatial variability. This is achieved by overlaying a mesh (or grid) on the model area and, hence, identifying a large number of unique model 'cells'. Recharge for a model consists of values for all recharge components for every model cell.

Model calibration is based on a very large number of observed water levels within the modelled area. These levels have been monitored by DPI Water in many areas of NSW over many years. The calibration process consists of building a model with assumed values of the many (several hundred) unknown parameters, running the model to predict water levels in the modelled area, comparing these levels with observed levels and then iteratively adjusting the model parameters to optimise the match between model predicted levels and observed levels.

For more information on groundwater models used by DPI Water please refer to www.water.nsw.gov.au/Water-Management/Modelling/Groundwater/default.aspx.

Dealings rules for alluvial groundwater sources

Dealings (trading) rules are intended to provide for efficient water markets whilst recognising and protecting the needs of the environment and third-part interests. In most macro plans, dealings area allowed within a groundwater source but not into or out of the groundwater source.

Consistent with the Minister's dealing principles there is no trading permitted between the six alluvial groundwater sources covered by the Murrumbidgee Unregulated water sharing plan.

For the Gundagai Alluvial Groundwater Source trade is also prohibited between the Tarcutta Alluvial Management Zone, which is not linked to surface water rules, and the Jugiong Alluvial Management Zone which is linked to the Murrumbidgee Regulated River high security AWDs.

Rules for water supply works approvals

In accordance with the principles of the WMA 2000 the Murrumbidgee Unregulated water sharing plan sets rules to minimise the cumulative impacts resulting from groundwater extraction. To do this, the plan specifies rules which prohibit new or amended works from extracting water within certain distances of other water users, contaminated sites, groundwater-dependent ecosystems (see following section) and groundwater dependent

culturally significant sites. This is to prevent unacceptable or damaging levels of draw-down occurring in the local vicinity of these users and sites.

A standard set of distance criteria for common groundwater aquifer types (for example fractured rock, alluvium, coastal sands and porous rock) was produced by comparing the various rules in similar geological provinces. The standard rules were then endorsed by the State Groundwater Panel.

This process has resulted in consistent rules across aquifer types considered the most current thinking in terms of managing local impacts of extraction and protecting groundwater-dependent ecosystems. However, the plan development process allows for changes to the rules to cater for local conditions. The distance criteria may be altered due to a number of different factors, such as lot size where property sizes may lead to different interference distance criteria, aspects of the local hydrology and groundwater dependence of town water.

Regional staff made draft recommendations on rules for the plan which were then compared against the standard rules. The IRP then made a recommendation for public exhibition. Opinion was sought from stakeholders during public exhibition and the IRP made the final recommendation to the Minister as to which rule would be adopted, striving to remain consistent with the standard rules where possible while being sensitive to any unique attributes of the groundwater sources in the plan area.

For new works there are rules to:

- minimise interference between neighbouring works;
- locate works away from contaminated sites;
- protect water levels in groundwater dependent ecosystems;
- protect groundwater dependent culturally significant sites;
- manage surface and groundwater connectivity; and
- manage temporary local impacts that may affect water levels, water quality and aquifer integrity.

Groundwater dependent ecosystems

Groundwater dependent ecosystems (GDEs) are ecosystems which have their species composition and natural ecological processes determined to some extent by the availability of groundwater. GDEs can include cave systems, springs, wetlands and groundwater dependent endangered ecological communities.

High priority GDEs are identified during the planning process and are listed in a schedule to the plan. The IRP then has the opportunity to review and amend the GDE list as well as the rules that have been developed to protect them based on their expertise.

The list of high priority GDEs compiled at this stage can be amended as further GDEs are identified during the life of the plan.

No GDEs have been identified for the six alluvial groundwater sources included in the Murrumbidgee Unregulated water sharing plan.

Managing extraction in alluvial groundwater sources

Long Term Average Annual Extraction Limit

For this and other similar plan areas, NSW has resolved that the long-term average annual extraction limit (LTAAEL) for highly connected and alluvial groundwater resources within NSW's portion of the Murray-Darling Basin shall be set equal to current average usage unless there is no available usage data, connectivity can be demonstrated to be minimal or

in unique circumstances. This is based on the principle that current levels of groundwater pumping are considered to be having acceptable impacts on surface water sources. Any extraction beyond this level will result in additional impact on the rivers, groundwater dependent ecosystems and other users of these connected water resources.

LTAELs have been determined for each of the six alluvial groundwater sources as detailed below.

Billabong Creek Alluvial Groundwater Source

In the Billabong Creek Alluvial Groundwater Source the total water requirements and historical water usage are considerably less than the estimated recharge into the groundwater source. If the LTAEL was set at current levels of extraction there is a high likelihood that town water supply and the salt interception scheme would use nearly all the water available for use in a number of years. This would result in a very limited volume of water available to all other water users. This issue triggered further consideration of the circumstances in the Billabong Creek alluvium.

The salt interception scheme pumps water from the deeper aquifer to reduce the pressure on the shallower aquifer to prevent saline inflows to the Creek at Morgan's Lookout. This suggests that relieving pressure in the deep aquifer by groundwater pumping at a sustainable level to enhance downward leakage from shallow to deep aquifer is beneficial.

As the connection between the aquifer and Billabong Creek is considered minimal, the IRP and the SGP agreed to allow the LTAEL for Billabong Creek Alluvial Groundwater Source to be based on a risk assessment.

The risk assessment considers two sets of risks;

- risks to the aquifer; and
- socio-economic risks to security of access to water.

Billabong Creek Alluvial Groundwater Source was deemed to have a high risk to security of access to water due to the low reliability of water in Billabong Creek and the lack of large dam sites. It was deemed to have a moderate aquifer risk as over-pumping could mobilise saline water.

The risk assessment process recommended that 60% of recharge be available for extraction. Therefore the LTAEL was set at 60% of recharge which is equal to 7,500 ML/yr.

Bungendore Alluvial Groundwater Source

There are no usage records for the Bungendore Alluvial Groundwater Source. Usage is predominantly for town water supply and there are very few licence holders. Therefore it was not possible to set the LTAEL on the basis of historical use. Instead a risk assessment was undertaken similar to that described above for Billabong Creek Alluvial Groundwater Source.

Bungendore Alluvial Groundwater Source was deemed to have a high risk to security of access to water due to the low reliability of surface water. It was deemed to have a low aquifer risk as sustainable management practices could be initiated to avoid any impacts on the aquifer.

The risk assessment process recommended that 70% of recharge be available for extraction. Therefore the LTAEL was set at 70% of recharge which is equal to 1,268 ML/yr.

Gundagai Alluvial Groundwater Source

The LTAEL for the Gundagai Alluvial Groundwater Source is 1,926 ML/yr, defined by the sum of:

- an estimate of usage from bores supplied by State Water and water users; plus,
- an estimate of basic landholder rights.

The LTAAEL was based on the sum of each individual's maximum five year average usage over the metered period from 2000 to 2010.

Kyeamba Alluvial Groundwater Source

The LTAAEL for the Kyeamba Alluvial Groundwater Source is 723 ML/yr, defined by the sum of:

- an estimate of usage from bores supplied by State Water and water users; plus
- an estimate of basic landholder rights.

The LTAAEL was based on the sum of each individual's maximum five year average usage over the metered period from 2000 to 2010.

Mid Murrumbidgee Zone 3 Alluvial Groundwater Source

The LTAAEL for the Mid Murrumbidgee Zone 3 Alluvial Groundwater Source is 30,176 ML/yr, defined by the sum of:

- an estimate of usage from bores supplied by State Water and water users; plus
- an estimate of basic landholder rights.

The LTAAEL was based on the sum of each individual's maximum five year average usage over the metered period from 2000 to 2010.

Wagga Wagga Alluvial Groundwater Source

The Wagga Wagga Alluvial Groundwater Source has two separate extraction limits. These are for:

- Local Water Utilities - set at 16,998 ML/yr, defined by the sum of average usage (2000/01 to 2009/10) from bores metered by State Water; and
- All other users – set at 3,650 ML/yr defined by the sum of:
 - average usage (2000/01 to 2009/10) from bores metered by State Water; plus
 - an estimate of basic landholder rights.

The LTAAEL was based on the sum of each individual's maximum five year average usage over the metered period from 2000 to 2010.

Two separate extraction limits were established to assist in managing local impacts and allow water to be accessed by users other than local water utilities.

Local water utilities held a significant portion of entitlement. Establishing one extraction limit based on usage could see access by other users erode over time.

This area had already been experiencing drawdown issues. It was important to establish a clear extraction limit for local water utilities who extract most of the water. This outcome was negotiated with local utilities who also wanted a sustainable level of extraction to inform the development of their integrated water cycle management strategies and demand management strategies. If local water utilities require more water in the future than the limit provided in the plan, a review would be undertaken to look at options.

Growth in use

Extractions are managed to the LTAAEL. Should growth in extractions above the LTAAEL be assessed to have occurred, an appropriate growth-in-use response will be taken. The growth-in-use response described in the plan is one which allows for the peaks and troughs of usage above and below the average, over the period from which the LTAAEL has been defined, to be replicated. A response is triggered if the average annual usage over the averaging period exceeds the LTAAEL by more than the tolerance threshold.

In the Murrumbidgee downstream of Burrinjuck Dam and Billabong catchments where flows and the recharging of alluvial aquifers vary considerably, a five year averaging period and a tolerance threshold of 10% was recommended by the IRP. The longer averaging period and increased threshold was chosen by the IRP to minimise the impacts of climatic variability. In the Bungendore Alluvium catchment climate variability is not as extreme so a three year averaging period and a tolerance threshold of 5% was recommended by the IRP.

Available water determination

Available water determinations (AWDs) are primarily used to credit water into a licensee's water allocation account. The AWD for a water source is used to manage growth in extractions above the LTAAEL. If growth is assessed to have occurred, then maximum AWDs will be reduced to respond to this growth, that is, a maximum AWD of less than 1 ML per unit share.

As detailed below, AWDs will be applied differently within the Jugiong Management Zone within the Gundagai Alluvial Groundwater Source to the remainder of the alluvial groundwater sources within the plan area.

Jugiong Alluvial Management Zone

To recognise the connection between the Jugiong Alluvial Management Zone and the Murrumbidgee Regulated River, the AWD for licences within the Jugiong Alluvial Management Zone has two components:

- a river recharge component (this is based on the percentage of the Gundagai Alluvial Groundwater Source LTAAEL derived from river recharge) that will fluctuate in accordance with the availability of resources in the regulated river, that is, if the AWD for high security licences within the Murrumbidgee Regulated River is zero then this portion of the AWD for the Jugiong Alluvial Management Zone would also be zero; and
- a rainfall and other recharge component (this is based on the percentage of the LTAAEL derived from rainfall/ other sources of recharge) that will be consistently available on a long-term average basis.

The river recharge component will be linked to the AWD for the Murrumbidgee Regulated River (high security) access licences. This is in recognition of the need to not increase regulated river losses during periods of reduced surface water availability. If these losses were allowed to exacerbate, then this potentially impacts future allocations for high priority surface water licences. Linking AWDs will therefore protect against increasing losses from the Murrumbidgee Regulated River to the groundwater, particularly during times of reduced allocations in the Murrumbidgee Regulated River.

The AWDs for the Jugiong Alluvial Management Zone will be based on 32% of the AWD for the Murrumbidgee Regulated River (high security) access licence AWD, plus 68% of the aquifer access licence AWD or lower amount as a result of a growth in use response.

The percentage of the AWD linked to the regulated river has been based on an assessment of the level of impact the previous pumping distribution had on the Murrumbidgee River. This indicated that approximately 32% of the water extracted under an average annual pumping season either originates from the regulated river or intercepts groundwater flow that would otherwise have discharged into the river (Broadstock 2009).

Tarcutta Alluvial Management Zone and all other alluvial groundwater sources

For those aquifer access licences in the Tarcutta Alluvial Management Zone within the Gundagai Alluvial Groundwater Source or any other alluvial groundwater sources in the plan area, AWDs will credit water annually to accounts, generally 1ML per unit share, or lower as a result of a growth in use response.

Carryover and water accounts

Carryover of entitlement from one year to the next is allowed in all of the groundwater sources except for the Bungendore Alluvial Groundwater Source.

In the Bungendore Alluvial Groundwater Source the maximum amount of water permitted to be taken from this water source in any one water year is equal to the water allocation accrued in the water access licence account for that water year. The reason for this is that Bungendore Alluvial Groundwater Source has a relatively small storage volume.

The Billabong Alluvial Groundwater Source has a carryover of 200%. This was selected as the entitlement in the water source (excluding local water utilities and the salt interception scheme) is less than half of the LTAAEL and even if the full amount of carryover was extracted in a year it is unlikely to reach the LTAAEL.

Advice received from licence holders was taken into account in refining the carryover rules for the Gundagai, Mid Murrumbidgee, Wagga Wagga and Kyeamba Alluvial Groundwater Sources.

In the Gundagai and the Mid Murrumbidgee Zone 3 Alluvial Groundwater Sources carryover of 30% is permitted. This figure allows flexibility for licence holders to account for climatic variability but will limit the total amount of water used in a year which will reduce the likelihood of a growth in use occurring.

In the Wagga Wagga and Kyeamba Alluvial Groundwater Sources carryover of 40% is permitted. This figure allows flexibility for licence holders to account for climatic variability and is more than in Gundagai and Mid Murrumbidgee Zone 3 as the likelihood of a growth in use occurring in Wagga Wagga and Kyeamba is less than for Gundagai and Mid Murrumbidgee Zone 3.

Refining the rules for local circumstances

Some water sources have unique circumstances that require additional consideration and negotiation. Often these water sources are split into management zones to allow better management of specific areas. The water sources listed below have water sharing rules that differ from the standard approach, and have been designed specifically for that area. In some cases these rules were developed by the IRP, however in many cases the initial rule was changed as a result of feedback received during consultation.

Table 12 outlines the changes made by the IRP to the initial water sharing rules as a result of public exhibition.

Table 12: Changes to groundwater sharing rules as a result of public exhibition

Water source	Change to water sharing rules	Justification
Billabong Alluvial Groundwater	New bores (excluding replacement bores) are to be located 500m from an aquifer access licence, BLR, local water utility and monitoring bore, and 250m from a boundary fence.	500m is appropriate based on property size. Hydrogeological assessment and local impact assessment can be applied to manage any impacts on existing bores.
Bungendore Alluvial Groundwater	New bores (excluding replacement bores) are to be located 750m from aquifer access licence, BLR, and local water utility bore, 400m from a monitoring bore, 200m from a boundary fence and 40m from a river bank.	Minimises impacts on existing licence holders, Accepted by licence holders.
Mid Murrumbidgee Alluvial Groundwater	Update recharge data to include 2010 data.	Use the best available data which results in the most up to date estimates of recharge.
Gundagai Alluvial Groundwater	Combine the alluvial groundwater in Tarcutta Creek with that upstream of the Tarcutta Creek confluence and make it one water source – the Gundagai Alluvial Groundwater Source with two management zones: <ul style="list-style-type: none"> • The Jugiong Alluvial Management Zone, and • The Tarcutta Alluvial Management Zone 	Reduces the risk of a growth in use in the Tarcutta Alluvial Management Zone.
Mid Murrumbidgee Alluvial Groundwater	Carryover set at 30% for Mid Murrumbidgee Zone 3, and Gundagai Alluvial Groundwater Sources. Carryover set at 40% for Wagga Wagga and Kyeamba Alluvial Groundwater Sources.	Gundagai – Jugiong Alluvial Management Zone is highly connected, carryover matched to surface water to limit impact on surface water sources. Mid Murrumbidgee Zone 3 - 30% as most licence holders want no carryover or only a small amount due to risk of growth in use trigger. Panel felt that small amount of carryover is useful to manage climate variability and if GIU occurs. 30% agreed to as the smallest amount of carryover that would be useful to licence holders. Wagga Wagga and Kyeamba -40% same reasons as Zone 3 but lower expected growth so higher carryover permitted.

Water source	Change to water sharing rules	Justification
<p>Mid Murrumbidgee Alluvial Groundwater</p>	<p>Establish the following 4 water sources - Gundagai, Kyeamba, Mid Murrumbidgee Zone 3, and Wagga Wagga Alluvial Groundwater Sources.</p> <p>No trade to occur between any water sources, trade within only.</p>	<p>Restricts growth in each water source to that generated by activation of licences within the water source.</p> <p>Licence holders bear the cost of activation in their respective areas rather than the cost of growth being socialised.</p> <p>Managing to separate LTAAELs and prohibiting trade between water sources will reduce the likelihood of a growth in use as a result of trade in.</p> <p>The scale of inactive entitlement provides market opportunities for development within each water source.</p> <p>Clear separation of Wagga Wagga from other areas, in order to manage large proportion of town water supply extraction and any localised drawdown issues.</p> <p>While the ratio of LTAAEL/entitlement will be lower for some areas such as Kyeamba Creek, this is offset by the greater ability to manage impacts at a local level.</p> <p>It is easier to achieve local agreement to manage the resource should drawdown issues arise than to manage across the whole area.</p>

Adaptive management

Adaptive management refers to the practice of change in response to new information such as monitoring or some other improvement in understanding. In the case of water sharing plans, such information could include socio-economic studies, hydrological modelling, ecological studies and information about Aboriginal cultural values.

Adaptive management is a requirement of both the WMA 2000 and the National Water Initiative, and has been allowed for during the life of the Murrumbidgee Unregulated water sharing plan through the inclusion of amendment provisions. These provisions allow some aspects of the water sharing plan to be changed within defined limits. Specific amendment provisions are discussed below.

Monitoring, evaluation and reporting are key activities for the adaptive management of water sharing plans. Further information on these is provided below.

Amendment provisions

Standard amendments that apply to all water sharing plans include:

- amending water sources, management zones or EMUs;
- establishing new or additional flow classes in any water source where management zones are added or amended;
- amending water sources for which dams on third order streams or higher will not be granted;
- amending requirements for metering or record keeping in relation to licensed access works; and
- updating information in Schedules or deleting them if no longer required.

The Murrumbidgee Unregulated water sharing plan also includes a number of specific amendments that may be made to the plan during its 10 year period of operation. These amendment provisions were part of the rule development process undertaken by the IRP.

Cease-to-pump in unregulated water sources

Cease-to-pump (CTP) conditions may be amended after year five of this plan if a new gauge is installed in the:

- Bredbo Water Source;
- Yass Upper Water Source;
- Murrumbidgee I Water Source; and
- Jugiong Water Source.

The CTP in the Numeralla East Water Source may be amended to less than or equal to 9 ML/day at Numeralla River at the Rose Valley flow gauge (41000206) after year five of the plan if there is no significant adverse impact on users.

The CTP may be modified in the Murrumbidgee I, Murrumbidgee II or the Goodradigbee Water Source so as to:

- give effect to the protection of any environmental releases made from Snowy Hydro storages within these water sources; or
- give effect to an agreement between the New South Wales Government and the ACT Government for the management of water released from Tantangara Dam for the ACT.

Stock and domestic access licences are exempt from the CTP rules for the first five years of the plan, when water is being taken for the purpose of stock watering. The plan may be amended to extend the exemption beyond the five year period if the outcomes of a review demonstrate that the CTP rules will cause unacceptable socio-economic impacts.

Planned environmental water in groundwater sources

All of the alluvial groundwater sources may be amended to vary the amount of recharge reserved as planned environmental water as a result of recharge studies undertaken.

LTAEL in groundwater sources

All alluvial groundwater sources may have their LTAEL modified as a result of the granting of a salinity and water table management access licence in the groundwater source.

The Billabong and Bungendore Alluvial Groundwater Sources may have their LTAEL modified as a result of recharge studies undertaken.

The Wagga Wagga Alluvial Groundwater Source has two LTAELs: one for local water utilities and one for all other users. If a growth in use response occurs to either of these categories there will be a reduction in the AWD for that category only. It will not immediately have an impact on the other category. However, if a growth in use response occurs for local water utilities a review will be conducted that considers the:

- urban water supply requirements;
- impacts associated with an increase to the local water utility LTAEL and a corresponding decrease in the LTAEL for all other users; and
- the impacts of reducing AWDs for local water utility access licences in the Wagga Wagga Alluvial Groundwater Source to return extractions to the LTAEL.

This study could result in;

- an increase to the LTAEL for local water utility access licences; and
- a reduction in the LTAEL for other users.

The Mid Murrumbidgee Zone 3, Kyeamba, Wagga Wagga, and Gundagai Alluvial Groundwater Sources may have their LTAEL modified based on new information that demonstrates that:

- a methodology is available that more accurately represents the history of extraction at the commencement of the plan than the methodology used to determine the history of extraction for the purpose of establishing the LTAEL; or
- the connectivity between the relevant groundwater sources and surface water sources is limited.

Trade rules in groundwater sources

Trading rules may be amended to restrict trade within the Kyeamba, Gundagai, Mid Murrumbidgee Zone 3 or Wagga Wagga Alluvial Groundwater Sources if the annual extractions in the groundwater sources exceed the LTAEL for that groundwater source in any of the first five years of the plan.

Monitoring, evaluation and reporting

DPI Water has developed a monitoring, evaluation and reporting framework in collaboration with key stakeholders. The framework conforms to NSW and Commonwealth government guidelines for monitoring, evaluation and reporting, and demonstrates an adaptive management approach to water planning required under the principles of the WMA 2000. The framework aims to inform the community of the outcomes of water sharing plans and to

collate the results of various legislatively required evaluations and relevant knowledge to inform the review of the water sharing plans. The framework will assess the inputs, outputs and outcomes of the water sharing plans and their operations. The assessment will consider:

- the process of plan development (appropriateness);
- the performance of the plan during operation (efficiency); and
- the socio-economic, environmental and cultural outcomes of the plan (effectiveness).

The main strategies in place to assist in evaluating water sharing plans include:

- assessment of performance indicators (using an environmental flows monitoring and modelling program);
- an audit of plans; and
- review of each plan at the end of its ten year term.

Performance indicators

Part 2 of the water sharing plan includes a number of standard performance indicators that will be monitored over the life of the water sharing plan. It is not practical to monitor all issues in all water sources. The performance indicators identify that monitoring will be undertaken for specific issues in key water sources. The actual procedure for monitoring each indicator may change over the period of the water sharing plan as improved methods are developed.

In order to assess performance indicators, DPI Water has established an environmental flows monitoring and modelling program which is designed to make the results of environmental flow studies more transferable between water sources and to develop more generic relationships between flow, hydraulics and ecological responses. This will enable a more efficient and effective evidence based approach to support monitoring and evaluation of water sharing plans in NSW.

Audit

The WMA 2000 requires that water sharing plans be audited regularly, at intervals of not more than five years, to determine whether the provisions of the plan are being implemented. Under section 44 of the Act the Minister for Lands and Water must appoint an Audit Panel to undertake this review.

The Audit Panel reflects the membership of the State Interagency Panel for water sharing and comprises representatives from DPI Water, OEH, DPI Agriculture and LLS. Representatives from the NSW Natural Resources Commission and NSW Fisheries are invited to participate in the audit process as observers.

Reflecting the requirements of the WMA 2000 the focus of the audit is on the extent to which the provisions in the plan have been implemented. The audit does not attempt to assess the outcomes or effectiveness of the plan in achieving its objectives (this is considered by DPI Water through its monitoring and evaluation process).

When conducting an audit the panel will review a range of analysis and material provided by DPI Water to:

- identify patterns of implementation activities across water source types, across plans and types of water sharing plan provisions;
- identify actions required to address instances of partial and non-implementation;
- develop broad recommendations for improving the implementation of existing plans and the robustness of new plans; and

- identify opportunities for linking the audit findings with other related processes, particularly the review of catchment action plan targets.

Plan review

At the end of the water sharing plan's 10 year life the Minister may, on recommendation by the NRC (under Section 43A of the WMA 2000), extend a water sharing plan for another 10 years or replace the plan. An extension does not allow for any changes to the water sharing plan. If any changes are proposed, then a replacement water sharing plan needs to be prepared.

The WMA 2000 requires that when deciding whether to extend or replace an existing plan, the Minister must consider

- the most recent audit of water sharing plans conducted under section 44; and
- a report from the NRC prepared within the previous five years, on the extent to which the water sharing plan has contributed to relevant state-wide natural resource management standards and targets of the relevant LLS catchment action plan.

Glossary

Many of the terms in this document are defined in the WMA 2000 and are therefore not redefined here. However, there are some terms not included in the legislation that are defined below to assist with understanding the water sharing plan.

Account water: The balance in an access licence water allocation account at a particular time. An access licence water allocation account records water allocations accrued under the licence as well as water allocations taken, assigned or re-credited. The operation of the account is also governed by rules for the carrying over of credits from one accounting period to the next and rules for the maximum credit that may be allowed to accumulate in the account as established in a water sharing plan.

Alluvial, alluvium: Sediment deposited by a stream of running water, in particular along riverbeds or floodplains.

Aquifer: An underground layer of water-bearing permeable rock or unconsolidated materials (gravel, sand, silt or clay) from which groundwater can be usefully extracted. The volume of water stored in an aquifer, the rate at which water can recharge, the volume of water extracted from it, and the rate at which water can move through the aquifer are all controlled by the geologic nature of the aquifer.

Conversion factor: The adjustment factor that is to be applied to share components when they are cancelled and reissued in a different water source and vice versa, or as a different category. It is designed to allow movement of water from one water source to another or from one licence category to another whilst minimising the impacts on third parties of such movements. These impacts result in that the value of a unit of share component (in terms of the average water allocations) that result from it may vary from one water source to another or from one licence category to another.

Critical habitat: Areas of habitat (land or water) that are crucial to the survival of particular threatened species, populations or communities.

Cumulative impact: The combined impact of all surface water extraction.

Ecological values: The intrinsic or core attributes associated with naturalness, diversity, rarity and special features, but excluding representativeness used to classify water sources for apportioning water management rules.

Endangered ecological communities: Ecological communities listed in Schedule 1 of the *Threatened Species Conservation Act 1995* or Schedule 4 of the *Fisheries Management Act 1994*.

Ephemeral: Temporary or intermittent; for instance, a creek or wetland which dries up periodically.

Extraction of water: Removal of water from a river for off-stream storage or consumptive use.

Extraction management unit: A group of water sources; defined for the purpose of managing long-term annual average extraction.

Flow classes: The range of daily flow rates in a river which provides the framework for sharing water on a daily basis.

Flow duration curve: A plot that shows the percentage of time that flow in a stream is likely to equal or exceed some specified value of interest.

Flow gauge: A device used to measure the height of a river, from which the flow in the river can be calculated.

Flow reference point: The site from which the flow data is calculated to determine the rates associated with a flow class and then to implement the daily access rules during the life of the plan.

Full capacity: The volume of water that is impounded in the pool, lagoon or lake when the level of water in the pool, lagoon or lake is at the highest water level where there is no visible flow out of that pool.

Groundwater: The water beneath the earth's surface that has filtered down to the zone where the earth or rocks are fully saturated.

Groundwater dependent ecosystems: Ecosystems that rely on groundwater for their species composition and their natural ecological processes.

Long-term average annual extraction limit (LTAAEL): The target for total extractions (under all water access licences plus an estimate of BLR within an EMU) which is used to assess whether growth-in-use has occurred. The actual annual extractions (metered plus estimated) are averaged over a fixed period of time defined by the water sharing plan when comparing with the LTAAEL. If the fixed period of time is greater than one water year, then in any one water year, extractions can exceed the LTAAEL without triggering a growth-in-use response.

Macro water sharing plans: Plans which apply to a number of water sources across catchments or different types of aquifers. The macro planning process is designed to develop broader-scale plans covering most of the remaining water sources in NSW.

Management zone: An area within a water source used for defining the location of applicability of water sharing rules, but secondary to the water source. A management zone is more likely to be designated where local dealing restrictions are in place or where 'cease-to-pump' rules for works approvals apply.

Pools: Lentic water bodies (standing water), including anything falling within the definition of a "lake" found in the Dictionary of the WM Act, except for tidal pools and estuaries.

Riparian: Relating to or living or located on the bank of a natural watercourse, such as a river or stream.

Total daily extraction limit (TDEL): The total limit on the daily volume of water that access licence holders in a particular category can take from a flow class.

Visible flow: The continuous downstream movement of water that is perceptible to the eye.

Water sharing plan: A plan made under the WMA 2000, which sets out the rules for sharing water between the environment and water users within whole or part of a water management area or water source

Water year: The 12 months running from 1 July to 30 June.

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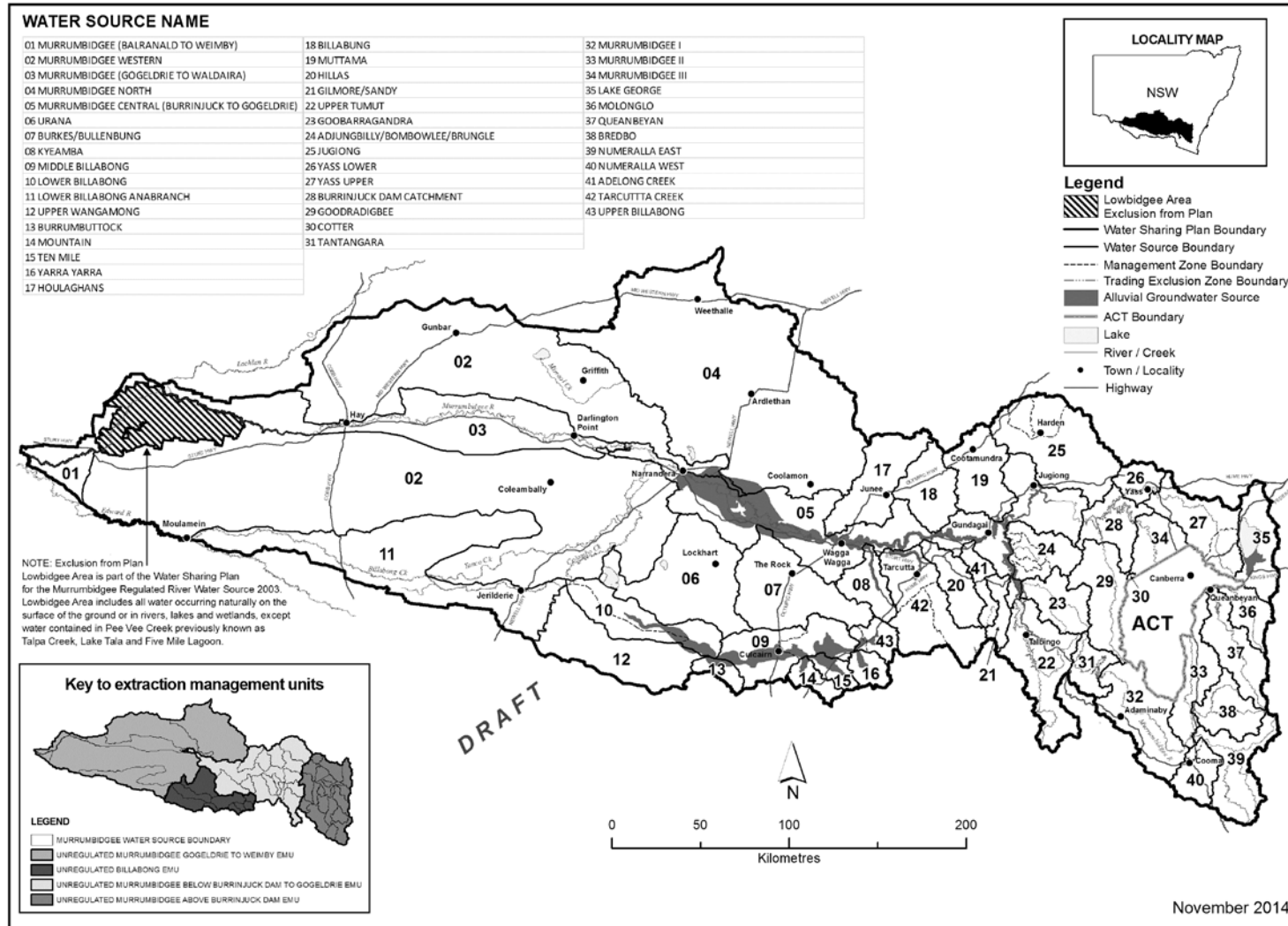
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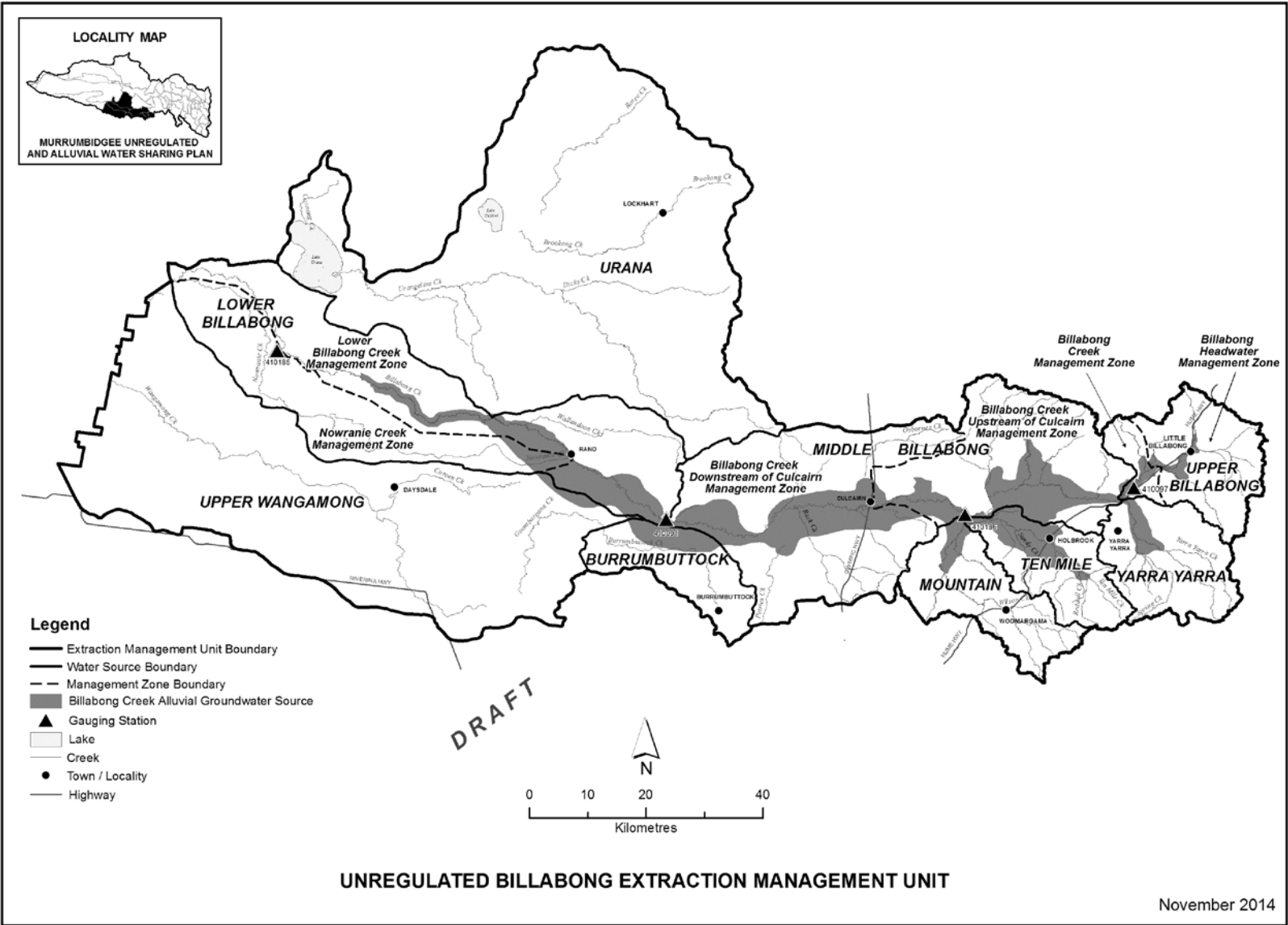
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Appendix 1: Water sharing plan maps

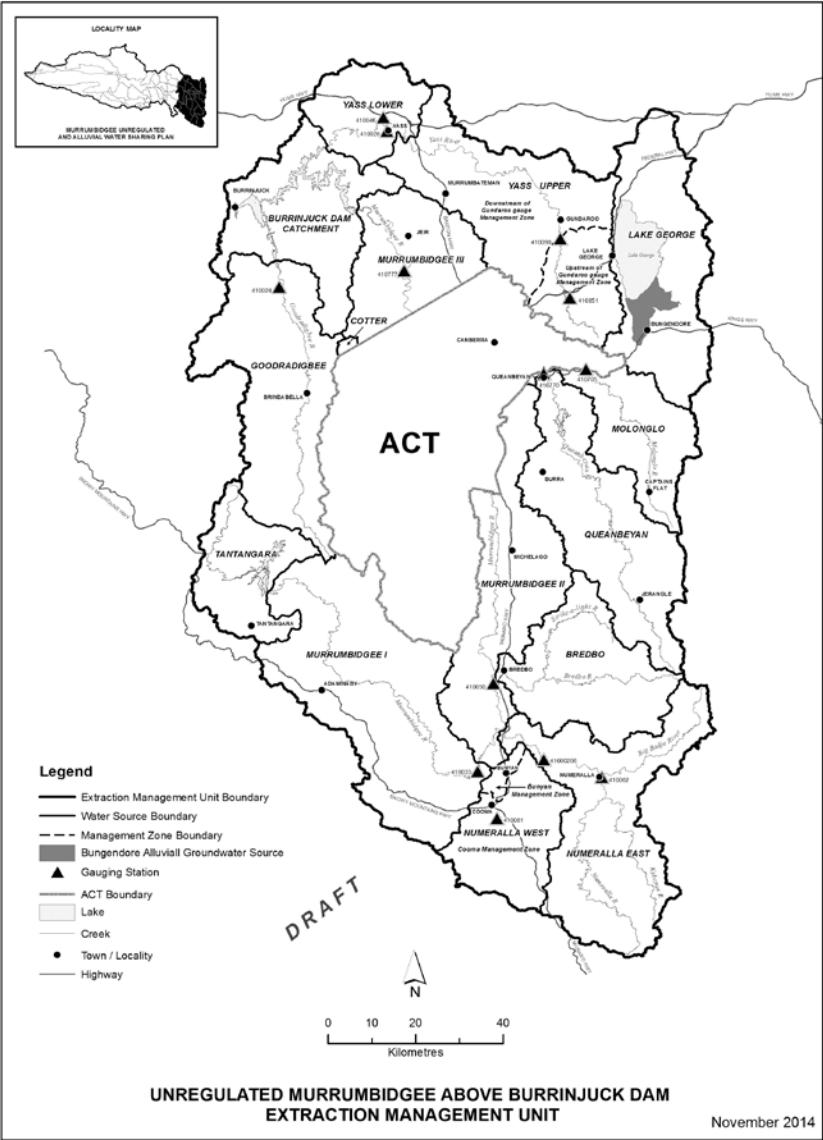
Map 1 of 5 – Plan overview



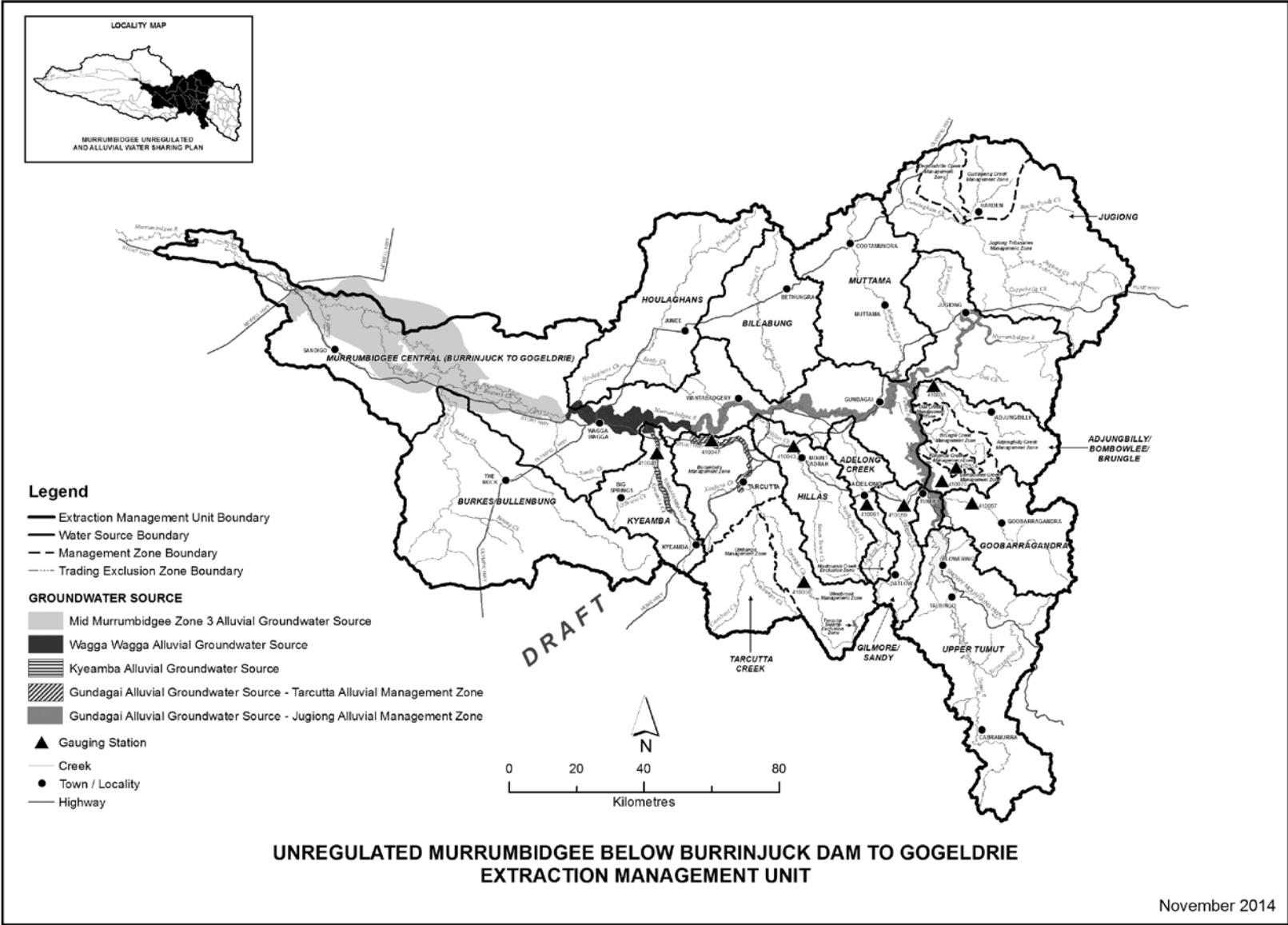
Map 2 of 5 – Unregulated Billabong Extraction Management Unit



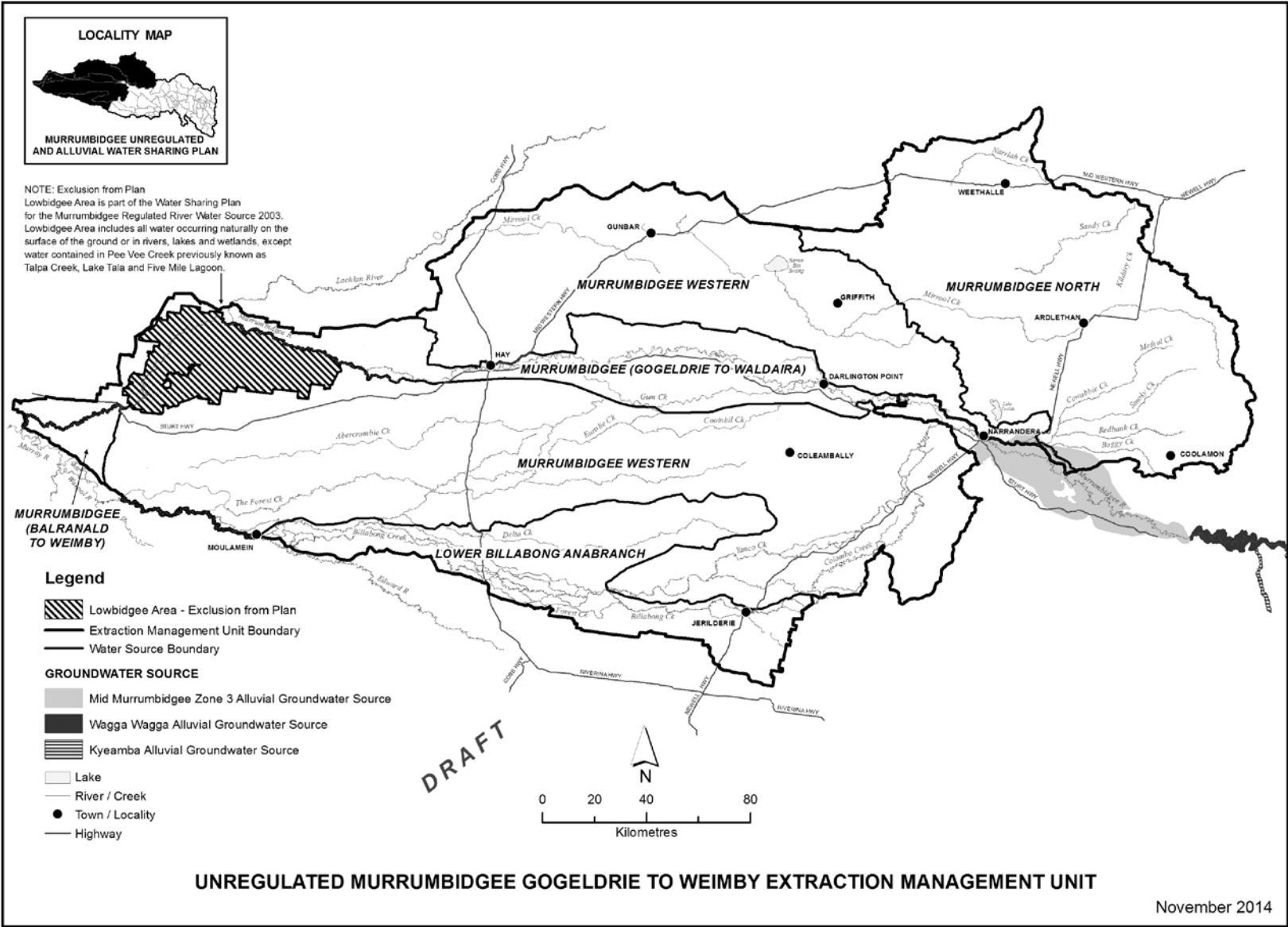
Map 3 of 5 – Murrumbidgee above Burrinjuck Dam Extraction Management Unit



Map 4 of 5 – Murrumbidgee below Burrinjuck Dam to Gogeldrie Extraction Management Unit



Map 5 of 5 – Murrumbidgee below Burrinjuck Dam Gogeldrie to Weimby Extraction Management Unit



Appendix 2. Identified threatened species

The macro water sharing plan process is concerned with protecting instream water values that relate to extraction. Therefore, only threatened species that are likely to be sensitive to extraction have been considered when assessing the water source values.

It should also be noted that some threatened species are highly sensitive to low flow extraction, whilst other threatened species, such as plants that occur in the riparian zone, are less sensitive. Threatened species considered to be highly sensitive to low flows are given a higher priority for protection.

Table 13 shows threatened species that are known (K) or expected (E) to occur in each water source.

Note: No data was available for Lake George or Murrumbidgee (Balranald to Weimby) Water Sources.

Disclaimer:

The Office of Environment and Heritage (OEH) has provided assessments on the presence of threatened species and their sensitivity to extraction to inform the classification of water sources through the macro water sharing planning process. The assessments were undertaken for the specific purpose of developing an initial classification of water sources. They were based on the most accurate and relevant data/ information sourced and analysed at the time.

Initial classifications were a first step to inform panel deliberations. Regional Panels considered a range of information and used local knowledge in determining a final classification. The assessments are not absolute – for example the absence of threatened species for an assessment does not necessarily mean the threatened species are not present.

These assessments should not be used for any purpose other than classification of catchment management units as part of the macro water sharing planning process.

Table 13: Threatened species and other environmental values known or expected to occur in the Murrumbidgee Unregulated water sources

		Adjungbilly Bombowiee Brungle	Billabung	Bredbo	Burkes Bullenbung	Burrinjuck Dam catchment	Burrumbuttock	Gilmore Sandy	Goobarragandra	Goodradigbee	Hillas
Fish Species	Murray hardyhead				E						
	Trout Cod	E	E	E	E	K				E	E
	River Snail										
	Southern pygmy perch	E	E		E	E	E	E	E	E	E
	Macquarie perch	E		E		E			E	K	E
	Silver perch	E	E		E	E	E	E	E	E	E
	Murray Cod					E				E	
Frog Species	Booroolong Frog	K	K		K	K	K	K	K	K	K
	Giant Burrowing Frog			K							
	Green and Golden Bell Frog			K		K					
	Littlejohn's Tree Frog			K							
	Spotted Tree Frog	K				K		K	K	K	K
	Yellow-spotted Bell Frog			K		K					
	Southern Corroboree Frog										
	Northern Corroboree Frog								K	K	
Birds	Australasian Bittern	K	K	K	K	E	K	K	K		K
	Black-necked Stork	K	K		K		K	K	K		K
	Black-tailed Godwit	K	K		K		K	K	K		K
	Brolga	K	K		K		K	K	K		K
	Magpie Goose	E	E		K	K	K	E	E		E
	Painted Snipe	K	K		K	K	K	K	K	K	K
	Olive Whistler	K	K	K	K	K		K	K	K	K
Other Fauna	Large-footed Myotis	K	K	K	K	K	K	K	K	K	K
	Greater Broad-nosed Bat					E		E	E	E	
Wet Flora Species	Western Water-starwort										
	Floating Swamp Wallaby-grass	K	K		K		K	K	K		K

		Houllaghans	Jugiong	Kyeamba	Lower Billabong	Lower Billabong Anabranch	Middle Billabong	Molonglo	Mountain	Murrumbidgee Central (Burrinjuck to Gogeldrie)	Murrumbidgee Gogeldrie to Walldaira
Fish Species	Murray hardyhead									K	E
	Trout Cod	E	E	E				E	E	K	E
	River Snail									E	E
	Southern pygmy perch	E	E	E	E	E	E	E	E	E	E
	Macquarie perch							E		E	
	Silver perch	E	E		E	E	E		E	E	E
	Murray Cod		E			E		E		E	E
Frog Species	Booroolong Frog	K	K	K	K		K		K	K	
	Giant Burrowing Frog							K			
	Green and Golden Bell Frog		K					K			
	Littlejohn's Tree Frog							K			
	Spotted Tree Frog	E									
	Yellow-spotted Bell Frog		K					K			
	Southern Corroboree Frog										
	Northern Corroboree Frog										
Birds	Australasian Bittern	K	K	K	K	K	K	K	K	K	K
	Black-necked Stork	K	K	K			K		K	K	
	Black-tailed Godwit	K	K	K	K	K	K		K	K	K
	Brolga	K	K	K	K	K	K		K	K	K
	Magpie Goose	K	K	E	K	K	K		K	K	K
	Painted Snipe	K	K	K	K	K	K		K	K	K
	Olive Whistler	K	K	K				K		K	
Other Fauna	Large-footed Myotis	K	K	K	K	K	K	K	K	K	E
	Greater Broad-nosed Bat		E					K			
Wet Flora Species	Western Water-starwort					E					K
	Floating Swamp Wallaby-grass	K	K	K	K	K	K		K	K	

		Murrumbidgee I	Murrumbidgee II & III	Murrumbidgee North	Murrumbidgee Western	Muttama	Numeralla East	Numeralla West	Queanbeyan	Tantangara	Ten Mile
Fish Species	Murray hardyhead			E	K						
	Trout Cod	K	K	E	K	E	E		E		E
	River Snail			E	E						
	Southern pygmy perch		E	E	E	E			E		E
	Macquarie perch	K	K		E		E	E	K	E	
	Silver perch			E	K	E					
	Murray Cod		E	E	E				E		
Frog Species	Booroolong Frog	K	K			K				K	K
	Giant Burrowing Frog	K	K				K	K	K		
	Green and Golden Bell Frog	K	K				K	K	K		
	Littlejohn's Tree Frog						K		K		
	Spotted Tree Frog	K								K	
	Yellow-spotted Bell Frog	K	K				K	K	K		
	Southern Corroboree Frog										
	Northern Corroboree Frog	K								K	
Birds	Australasian Bittern	K	K	K	K	K	K	K	K		K
	Black-necked Stork				K	K					K
	Black-tailed Godwit			K	K	K					K
	Brolga			K	K	K					K
	Magpie Goose		K	K	K	E					K
	Painted Snipe	K	K	K	K	K				K	K
	Olive Whistler	K	K			K	K	K	K	K	
Other Fauna	Large-footed Myotis	K	K	K	K	K	K	K	K	K	K
	Greater Broad-nosed Bat	E	E				K		K	E	
Wet Flora Species	Western Water-starwort				K						
	Floating Swamp Wallaby-grass			K	K	K					K

		Upper Tumut	Upper Wangamong	Urana	Yarra Yarra	Yass Lower	Yass Upper
Fish Species	Murray hardyhead						
	Trout Cod		E		E	E	E
	River Snail						
	Southern pygmy perch	E	E	E	E	E	E
	Macquarie perch	E	E			E	E
	Silver perch	E	E	E			
	Murray Cod	E	E	E			E
Frog Species	Booroolong Frog	K	K		K	K	K
	Giant Burrowing Frog						
	Green and Golden Bell Frog					K	K
	Littlejohn's Tree Frog						
	Spotted Tree Frog	K					
	Yellow-spotted Bell Frog					K	K
	Southern Corroboree Frog	K					
	Northern Corroboree Frog	K					
Birds	Australasian Bittern	K	K	K	K	K	E
	Black-necked Stork	K	K		K	K	
	Black-tailed Godwit	K	K	K	K	K	
	Brolga	K	K	K	K	K	
	Magpie Goose	E	K	K	E	K	K
	Painted Snipe	K	K	K	K	K	K
	Olive Whistler	K				K	K
Other Fauna	Large-footed Myotis	K	K	K	K	K	K
	Greater Broad-nosed Bat	E				E	E
Wet Flora Species	Western Water-starwort		E				
	Floating Swamp Wallaby-grass	K	K	K	K	K	

Appendix 3. Interagency Regional Panel and support staff

Table 14: Murrumbidgee Regional Panel-membership and expertise for 2012 plan development

Name	Agency	Role
Tracey Brownbill	NSW Office of Water	Agency representative, Chair
Gary Coady	NSW Office of Water	Agency representative
Giles Butler	Department of Primary Industries	Agency representative
Justen Simpson	Office of Environment and Heritage	Agency representative
John Francis	Murrumbidgee CMA	CMA observer
Patricia Bowen / Tracey Brownbill	Murray CMA	CMA observer

Table 15: Murrumbidgee Regional Panel-membership and expertise for 2015 plan replacement

Name	Agency	Role
Tracey Brownbill	NSW Office of Water	Agency representative, Chair
Giles Butler	Department of Primary Industries	Agency representative
Luke Pearce	NSW Fisheries	Agency representative
Paula D'Santos	Office of Environment and Heritage	Agency representative
Rob Kelly	Murrumbidgee CMA	CMA observer
David Clarke	Murray CMA	CMA observer

Table 16: Support staff membership and expertise for 2012 plan development

Name	Agency	Role
Rob Hoogers	DPI	Technical Support/ Alternate Representative
Marcus Wright	Murrumbidgee CMA	Technical Support / Alternative Representative
Adam Vey	DPI	Fisheries Observer
Danielle Doughty	NSW Office of Water	Plan coordinator
Kathryn Hair	NSW Office of Water	Plan support
Mark Mitchell / Nimal Kulatunga	NSW Office of Water	Plan support
Paul Simpson	NSW Office of Water	Technical Support
Lorraine Hardwick	NSW Office of Water	Technical Support
Clare Purtle	NSW Office of Water	Technical Support (licensing)
Daniel Hannon	NSW Office of Water	Technical Support (hydrometrics)
Eva Ciecko	NSW Office of Water	Plan support
Steve Webb/Tracie Scarfone	NSW Office of Water	Technical Support (licensing)

Appendix 4. Reference information used by the Interagency Regional Panel

DPI Water data sets

- Licensing Administrator System – the DPI Water statewide database holding the licence details including volume of entitlement, location details and stream orders.
- Hydstra – Hydstra is a DPI Water statewide database that holds all flow record data.
- Regional Groundwater Monitoring Network – DPI Water is developing a regional groundwater monitoring network to be used to monitor alluvial groundwater levels and assess stream / surface water connectivity.
- Volumetric Conversion Database – used to help determine the Peak Daily Demand for each water source.
- Regional Geographic Information Systems – DPI Water land use and topographic information

Other data sets

- Stressed rivers reports – used as the basis for identifying where there are instream barriers.
- Threatened species (fish) – Data supplied by NSW DPI.
- Threatened species (other) – Data supplied by OEH.
- Index of Social Disadvantage – Australian Bureau of Statistics.
- Employment in Agriculture - Australian Bureau of Statistics

Other agency data

- National Parks and Wildlife (OEH) Wildlife Atlas – statewide flora and fauna database
- NSW Fisheries (NSW DPI) modelled data sets (Fish Community Index, Fish Community Vulnerability).
- NSW Fisheries (NSW DPI) freshwater and saltwater recreational fishing database.