groundwater

“Groundwater is an important source of our fresh water. Right now, in many parts of Australia, groundwater use is either above or near the capacity of the resource to renew itself ...”

Australia has been and still is ‘mining’ its renewable resources (of groundwater) as if they were mined minerals. That is, they are being exploited at rates faster than their renewal rates, with the result that they are declining.

Jarred Diamond, *Collapse*, Viking Press, 2005, p. 378

In some parts of the Basin, groundwater levels are rising at alarming rates, and salinisation and the displacement of salt loads to the river systems are occurring. It is predicted that these processes will continue to severely degrade the usefulness of water resources in the Basin, in terms of the maintenance of healthy ecosystems and the provision of water of a suitable quality for irrigation and potable use.

D Ife & K Skelt, *Murray-Darling Basin groundwater status: summary report*, Murray-Darling Basin Commission, Canberra, 2004, p.10

Although it’s less visible than surface water, there is also a large groundwater resource lying under vast areas of Australia. In the drier and/or more inland parts of the continent, this is the major source of fresh water used in agriculture, mining and all domestic activities apart from human consumption. Approximately 21% of the fresh water we use is groundwater.[1]

Groundwater is accessed by drilling holes and installing pipes (commonly known as bores) down into underground strata which contain or enclose water. The water then comes to the surface either by pumping or by natural pressure.

The link between surface water and groundwater is crucial. When a new bore is sunk, the water drawn up is the base flow of the nearest river. Every time we look at surface water – in a lake, stream or river – we are actually looking at a ‘window’ into the underlying groundwater.

The flatness of our continent assists water to seep into aquifers, and Australia has vast underground reserves of such water. When rain falls onto the land it penetrates the soil. If enough falls, the water seeps down to a saturated layer called the water table. In different parts of the country, the water table is found at varying depths below the surface. Essentially, this water is held within layers of porous soils and rock.

We have many small aquifers and some very large ones. For example, the Great Artesian Basin is one of the largest aquifers in the world. Formed at least 200 million years ago, this multi-layered aquifer extends from the Gulf of Carpentaria to approximately 600 km north of Adelaide. Although the average depth is about 500 m, in some places water is contained to depths of 3000 m and it is estimated to contain 8700 GL.[2]

Water in some aquifers is very old, having entered the underground system hundreds, and even thousands, of years ago. Water in an aquifer can also be relatively new, entering by a process called aquifer recharge, where water leaks through geological flaws in the beds of rivers, lakes and the land surface. A lot of recharge occurs during prolonged and extensive flooding. Thus, while large amounts of water evaporate following a flood, much also seeps down through soil and rock formations to enter aquifers.

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A large part of rural and remote Australia is dependent on the supply of water from aquifers. The cities of Perth and Adelaide are also partly dependent. Each aquifer being used to supply water is divided into a number of groundwater management units. A unit can supply several hundred farming enterprises, a small town or even a mine.

Across Australia there are currently 535 such operational units supplying thousands of users. Each of these users is licensed to pump a specified amount of water during a prescribed time of year.[3] Only 14% of these operational units have some or all of their water use metered.[4]

For decades people were allowed to sink bores into these major aquifers and leave them flowing continuously. This has resulted in a significant drop in water pressure and, consequently, flow rates. For instance, across the Great Artesian Basin initial flow rates were more than 10 ML per day. These days, flow rates are in the range of 0.01–6 ML per day.[5]

There is now a national program underway to cap these bores so that water is released only on demand. Funding to complete this program has been included in Prime Minister Howard's recently released *A national plan for water security.*[6]

In a number of places there are so many people pumping water (both legally and illegally) that the total volume being removed from aquifers is in excess of the volume that enters by recharge in an average climate year. In such a situation, the aquifer is described as being 'over-allocated'.

A national assessment of Australia's water resources in 2000 indicated that 161 of the 535 groundwater management units were either nearly fully allocated or over-allocated.[7]

In our two biggest food-producing areas, the Murray-Darling Basin and the Great Artesian Basin, the known allocations of water already exceed the volumes of water that can be pumped on a sustainable basis.

As with surface water, the use of groundwater has increased dramatically since the early 1980s. In 1983–84 total groundwater use was 2634 GL. In just over a decade, this rose to 4962 GL – an increase of 88%.[8] It's now also known that, in areas of certain geomorphology, aquifers and rivers are linked so that if too much water is removed from the aquifer, available water in the river also decreases. Conversely, if too much water is pumped from the river, the recharge of the aquifer diminishes.[9]

What we must also take account of is that the adverse effects of excessive groundwater pumping on stream flow can accumulate over a long period. A recent report to the Federal Government presented case studies from the USA and China which show that the full effects of excessive groundwater pumping were not felt for several decades.[10]

> There is no free lunch here. It's very simple – every litre of water you pump out of the ground reduces river flow by the same amount.
>
> Dr Richard Evans, principal hydrogeologist, Sinclair Knight Merz, *Australian Financial Review,* 24 May 2007, p. 10

Table 1. Mean annual groundwater use (GL) by different use categories in all states and territories

STATE	IRRIGATION	URBAN/ INDUSTRIAL	RURAL	IN SITU	TOTAL (GL)
New South Wales	643	160	205	0	1008
Victoria	431	127	54	10	622
Queensland	816	265	541	0	1622
Western Australia	280	821	37	0	1138
South Australia	354	23	42	24	419
Tasmania	9	7	4	0	20
Northern Territory	47	48	33	0	128
Australian Capital Territory	2	0	3	0	5
TOTAL	2582	1451	919	34	4962

In most parts of the mainland, groundwater use is regulated through licensing. It is a major source of water for much of rural Australia and is also used in manufacturing and most household activities (apart from drinking).

Source: National Land and Water Resources Audit, Canberra, *Australian water resources assessment 2000,* NLWRA, Canberra, 2001, p. 58.

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> Does anyone have any idea what percentage of rainfall, if any, is added to the store of groundwater? It does seem that the ground is so dry that there is little chance of any rainfall penetrating more than a few inches. To keep drawing on this water without any measure of whether it is being replaced, even partially, seems very short-sighted.
>
> Castlemaine/Campbells Creek Water*mark* group

Figure 1. Major groundwater resources in Australia

Some of the fresh water that falls onto the land, and some of the fresh water flowing in rivers, can pass through geological strata and eventually accumulate in underground aquifers. This process has been going on in parts of Australia for millenia. By measuring the rate at which this water naturally accumulates in an aquifer, it's possible to calculate the rate at which water can be pumped from an aquifer on a sustainable basis.

Our groundwater resources are not as well defined as surface water resources, nor is their management as sophisticated. With a number of aquifers, excessive pumping is a major problem. There is national concern about the extent of groundwater removal from the Great Artesian Basin. The Basin has 535 groundwater management units and in 57 of these (approximately 10%) the rate of water removal exceeds the calculated sustainable yield. For another 104 groundwater management units (approximately 20%) the rate of water removal is 70–100% of the sustainable yield.

The map indicates four scenarios faced by the major aquifers across the country with the shading indicating the extent of groundwater allocation.

- Greater than 100% (i.e. more groundwater is being removed than the natural rate of recharge)
- Between 80% and 100%
- Between 30% and 70%
- Less than 30%

Source: Australian Academy of Technological Sciences and Engineering, *Water recycling in Australia, special report,* ATSE, Melbourne, 2004, ch. 1, p. 3, <http://www.atse.org.au/index.php>.

groundwater

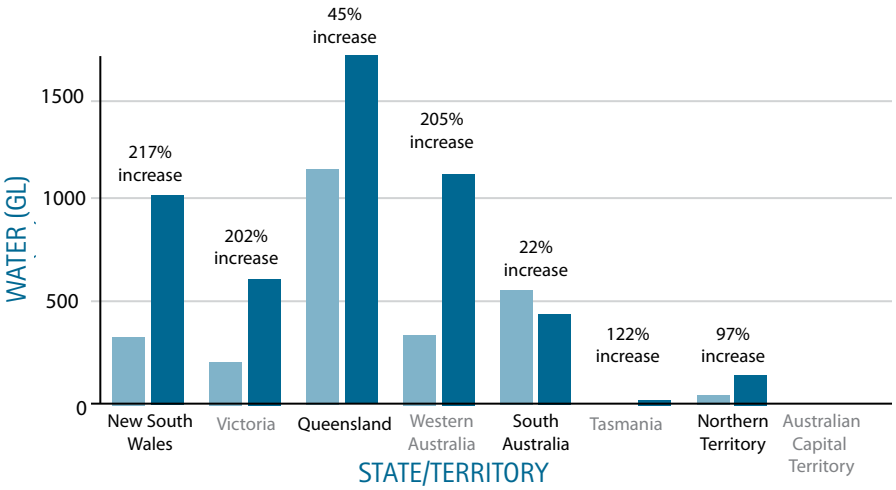

Figure 2. Change in mean annual groundwater use (in GL) in all states and territories between 1983 and 1984, and 1996 and 1997

Across Australia, since the 1980s there has been a dramatic increase in the amount of groundwater being pumped each year.

Source: National Land and Water Resources Audit, *Australian water resources assessment 2000*, NLWRA, Canberra, 2001, p. 64.

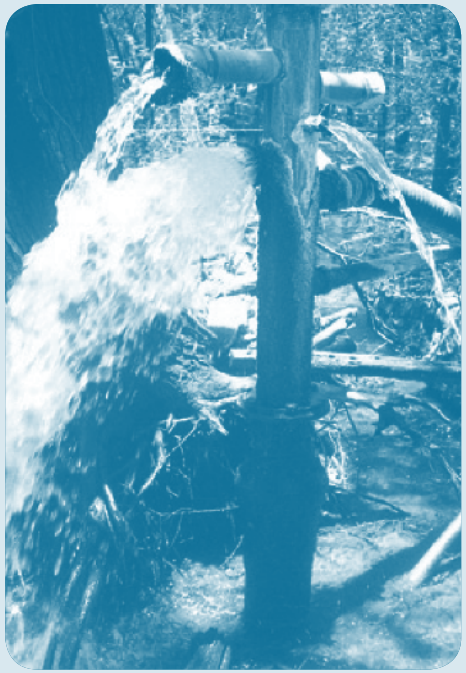

Image 1. Water running out of an uncapped bore

Groundwater is used extensively across Australia. It's essential for watering livestock and supplying farmhouses and many small industries in rural towns. In an uncapped bore, water rises to the land surface under pressure and runs out of the bore and into a trough or tank. Because these bores are either not fitted with closing valves or have valves that can no longer be closed off, the water runs continuously and a lot of it evaporates. Some bores have been allowed to flow in this way for decades. A national program is now being implemented to cap all bores in the Great Artesian Basin.

Source: Environment Protection Authority Queensland, *State of the environment 2003*, EPAQ, Brisbane, 2004, p. 56, <http://www.epa.qld.gov.au>

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10. R Evans, *The effects of ground water pumping on stream flow in Australia*, technical report to Land and Water Australia, 2007.

Some other useful sources

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