

A decade of dry

By Clinton Rakich

The past decade has been an exceptionally dry one in large parts of southern and eastern Australia. While much of tropical and central Australia has seen wet conditions through most of the past 10 years, for many parts of the south 1996 was the last year with significantly above-average rainfall.

The most extreme rainfall anomalies have been in the area around Melbourne, where falls during the past 10 years have widely been about 20% below the long-term average, and 10% below those of any other 10-year period in recorded history. Other areas where rainfall over the past 10 years has been the lowest on record are parts of western Victoria and adjoining south-eastern South Australia, parts of eastern Tasmania, the area around Perth in Western Australia, and a few locations in the Darling Downs and Burnett regions of south-eastern Queensland (Figure 1).

October 1996 is taken as the starting point for this dry period, as September 1996 was the last in a sequence of months with above-average rainfall in most of Victoria. It was also the end of the main 1996 rainfall season in south-west Western Australia, which was followed by a run of eight successive drier-than-average years in Perth. In New South Wales and Queensland, the downturn in rainfall has generally been a more recent phenomenon, starting in 2000 near the east coast and 2001 further inland.

The area of drier-than-average conditions covers most of southern and eastern Australia, including all major Australian cities except Darwin, and the vast majority of the nation's cropping areas. Over the 10-year period rainfall deficits have been most acute in the south-east and the south-west. In the south-west these

are an extension of a downward trend, which has been present since around 1970. In the south-east, however, they came at the end of a period of generally high rainfall that began about 1950.

The decline in rainfall in both south-western and south-eastern Australia has been particularly acute in the first half of the winter rainfall season (April–July), with much smaller changes in the late winter and spring (August–November). Poor autumn and early winter rains have been a feature of the southern Australian climate for several years, particularly since the El Niño of 1997, and may be an emerging signature of climate change. Rain bearing autumn/winter cold fronts are tracking further south than normal through the Southern Ocean and failing to reach the Australian continent. Concurrently high-pressure systems are becoming more dominant over the Australian continent's latitudes. The failure of autumn rains has particularly severe implications for southern Australian grain farmers who rely on autumn rains for early sowing and a long growing season to attain maximum crop yields.

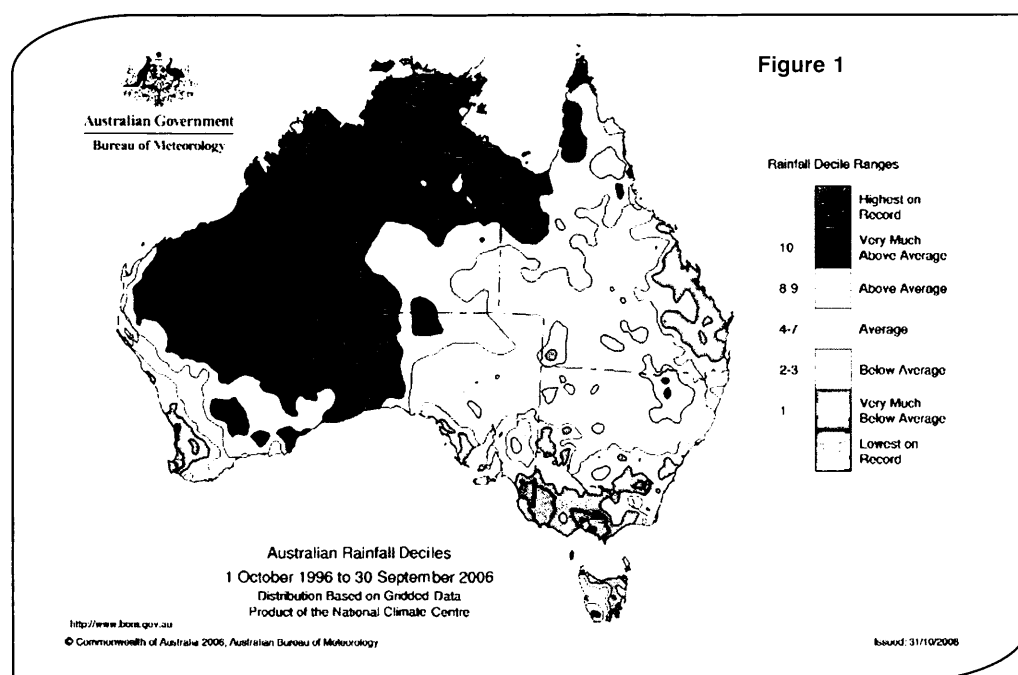
A significant feature of the past 10 years in many of the notably dry areas has been a lack of any sustained wet periods. While there have only been a few individual years with severe short-term drought (most notably 2002, but also 1997 in Victoria and 2001 in the south-west), the lack of wet periods has had a particularly severe impact on some large water storages, which are dependent on a small number of major flood events for a large proportion of their inflows. (As an example, 32% of the total inflows into Sydney's Warragamba Dam in the past 20 years have come from the wettest 2% of months).

This is illustrated by the situation at Moss Vale (NSW) and Toowoomba (Queensland). At Moss



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Vale, there has only been one month (August 1998) since 1992 with more than 200mm of rainfall, compared with a pre-1992 average of about one month in 15 above 200mm. At Toowoomba, with a long-term average of one month in 18 above 200mm, there have been no 200mm months since February 2001 (68 months). This has been a contributing factor to the acute water shortages currently affecting the Sydney and Brisbane regions, even though the 10-year rainfall in Sydney itself has only been 7% below average, and well above levels seen in the 1937–47 period.

Temperatures in eastern Australia since 1996

In addition to being very dry, the past 10 years has been a very warm period for most of eastern Australia. Daytime maximum temperatures have been particularly high, and have been the highest on record in almost all of eastern Australia south of the tropics. In most of this region maximum temperatures have been 0.5 to 1.0°C above the 1961–90 average, with a few areas exceeding 1.0°C. The situation has been more patchy for overnight minimum temperatures, and in Victoria (where the exceptionally dry conditions have led to unusually large diurnal ranges of temperature) minimum temperatures since 1996 have been below average, but large areas further north have also had their warmest overnight minimum temperatures on record.

2002–03—Our last major drought

A weak to moderate El Niño event in the Pacific during 2002–03 had a very strong impact in Australia. An El Niño event occurs as extensive warming of the central and eastern tropical Pacific Ocean leads to a major shift in weather patterns across the Pacific basin. The focus of convection and tropical thunderstorms migrates east away from the Australian/Indonesian region into the central Pacific. In Australia (particularly eastern Australia), El Niño events are associated with an increased probability of drier conditions. The major 2002–03 drought had rainfall deficiencies over the period March 2002 to January 2003 that ranked in severity and areal extent with the extreme droughts of 1902 and 1982–83. Practically all parts of the country were affected, and in southern areas this exacerbated the effects of several preceding years of dry conditions. The extreme dryness coincided with exceptionally warm conditions and new seasonal records were set for Australia wide maximum temperatures in autumn, winter and spring by a wide margin (records since 1950). Severe bushfires in eastern NSW, Canberra, and the mountains of south-east NSW/ eastern Victoria, and widespread water shortages, were some of the main effects. Widespread above to very much above average falls occurred in February 2003, raising hopes of a consistent period of wet weather to erase the effects of severe drought. However, this was not to be. Totals for the remainder of 2003 were insufficient in many areas to overcome

existing rainfall deficiencies, especially in parts of Queensland and south-east Victoria where 2003 was another dry year.

2006—a very dry year in southern Australia

After enduring the severe impacts of the 2002–03 El Niño induced drought, southern and eastern Australian communities hoped for a rain bearing La Niña event. La Niña events often follow El Niño events and have the opposite impact. During a La Niña event, warm Pacific waters and stronger winds push west across the Pacific towards Australia enhancing rainfall, often resulting in inland flooding. Unfortunately a La Niña event didn't eventuate and the period 2003–06 was characterised by a neutral Pacific Ocean and average to below average rainfall across much of eastern Australia. Without a sustained period of above average rainfall, much of southern and eastern Australia has not yet recovered from the severe deficiencies of 2002–03. In 2006, southern and eastern Australia once again began to dry as yet another El Niño event developed in the Pacific Ocean.

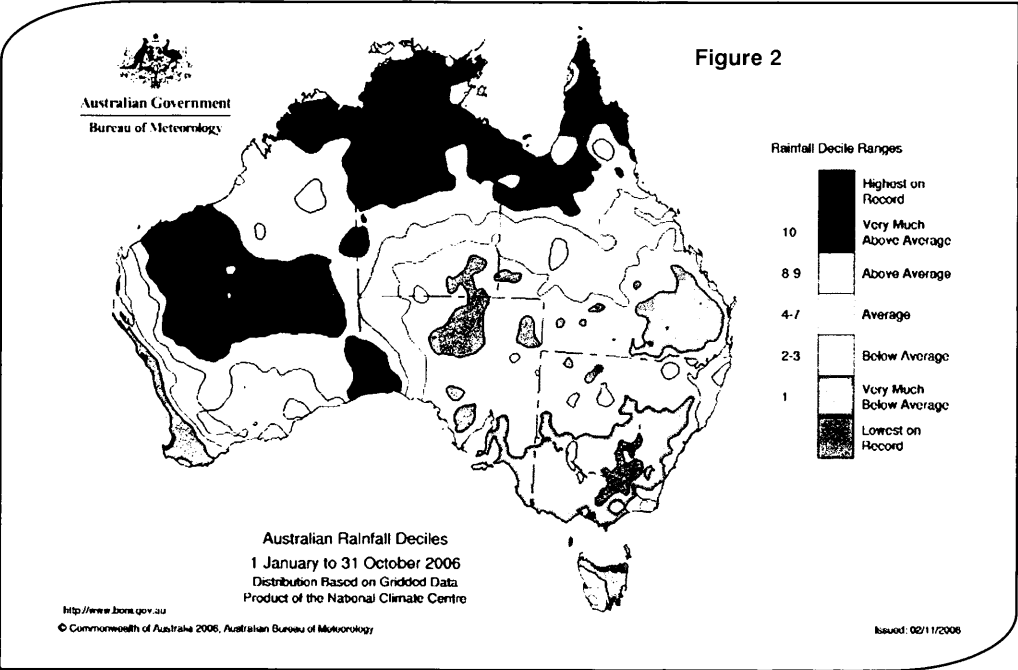
Many of the rainfall patterns seen in the past 10 years have continued in 2006, with generally well-below average rainfall for the January–September period in both south-eastern Australia (including Tasmania) and the south-west. At the time of going to print, a number

of major locations, including Hobart, Perth and Ballarat, were at risk of having their driest year on record in 2006 if below average rainfall continued for the remainder of the year (Figure 2). The snowpack on the Australian Alps was also at near-record low levels, mainly due to low precipitation in the alpine regions (although warm conditions in August and September also contributed to rapid melting).

August 2006 was the driest August in the historical record from 1900, based on the average rainfall across the entire Australian continent. The total area that was already deficient in autumn/winter rainfall at the beginning of the month expanded substantially, especially over southern Australia. September 2006 saw continued below average rainfall across southern and central parts of the mainland, with deficiencies generally expanding or intensifying over South Australia, New South Wales and Victoria. Furthermore, the dryness was exacerbated by temperatures that were well above normal.

With the drier and warmer than average conditions experienced through winter and spring came an early start to the southern Australian bushfire season. Fires broke out in all four south-eastern states during October as hot dry northwesterly winds sent maximum temperatures to record levels in many locations on 12 and 13 October. Temperatures in Sydney climbed to over 36 degrees on 13 and 14 October—the first time consecutive October

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days with temperatures this high have been recorded in nearly 150 years of records. The Bushfire Cooperative Research Centre has predicted above normal fire potential across much of Australia for the 2006–07 fire season due to high fuel loads in the north, drought in the south and the ongoing effects of the current El Niño event.

to enhanced global temperatures caused by anthropogenic climate change. If, as expected, global and Australian temperatures continue to rise through this century, demand for water from our already severely stressed resources will continue to escalate.

When will the rains return?

El Niño events usually loosen their grip on Australian rainfall during November and often close to average rainfall is recorded in the eastern states during summer. Atmospheric and oceanic conditions in the Pacific usually revert back to neutral or swing to a cool (La Niña) phase in late autumn. As with the 2002–03 El Niño we can only hope that the Pacific moves into a La Niña phase in 2007 and we have a sustained period of above average rainfall to replenish the nations depleted rivers, catchments and reservoirs.

Increasing demands on our water supplies

While historical records show five drier periods than present in the Murray Darling basin, especially during the period 1925 to 1948, extensive agricultural and urban development during the relatively wet period 1950 to 2000 has meant that water demand is at unprecedented levels. Many areas are unlikely to have experienced water supply deficits this severe in the past.

Australian rainfall exhibits high variability not only on the yearly time scale but also, and perhaps more importantly, the multidecadal timescale. Broad-scale changes in the ocean/atmosphere system across the entire Pacific basin, referred to as the Pacific Decadal Oscillation (PDO), occur on the multidecadal timescale. The PDO has a strong effect on the amount of rainfall across Australia, particularly during La Niña events. Understanding that this variability is an inherent part of the Australian climate is essential to planning sustainable developments in the future both in urban and rural areas.

The other critical factor increasing the severity of the current drought is record high temperatures across most of southern Australia, through much of the period 2001–06. These temperatures are at least in part attributable