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Land and Water

# Wealth from water: A national perspective


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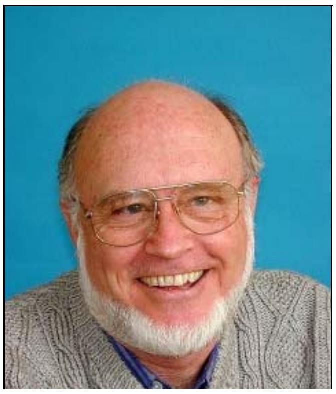
A presentation to the Wealth from Water Conference
14 March 2003 held at Wagga Wagga, NSW

December 2003

www.clw.csiro.au

# About the author

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Dr John Williams was raised on a grazing property on the southern tablelands of New South Wales. He was educated at the University of Sydney, where he graduated with a first-class honours degree in Agricultural Science and a doctorate in Soil Physics and Hydrology (1968).

After a seven-year period of overseas research and academic work, John joined CSIRO in Townsville, and spent the next 16 years working on the hydrology of tropical landscapes and on a range of land management problems, including salinity and soil erosion in the Burdekin Catchment.

Dr Williams, who was appointed Deputy Chief of CSIRO Land and Water at its inception, is well known for his analysis of the issues that confront Australian agriculture in being both productive and sustainable in terms of resource use and impact on the environment. He is a long-time advocate of the need for Australia to radically change land use so that it is more in sympathy with the functioning of the natural ecosystem.

His experience and background in agriculture production and its environmental impact, particularly of salinity and erosion, coupled with his strong record in coordination and delivery, ideally position him to make a significant contribution to the national debate on natural resource management, land use policy, and its implementation in Australia.

In November 2001, John was appointed Chief of CSIRO Land and Water.

# Wealth from Water: A national perspective


## Dr John Williams

Chief
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It is a pleasure and a privilege to be part of this important conference. John Anderson and Richard Pratt have already set the framework in their presentations, and much of what I have to say will be reiterating the most important points.

First, I need to acknowledge that many people have helped me prepare this presentation, and that the information and the ideas that I will be presenting are not all mine.

Water to wealth is an issue that confronts us all. We all want and know we need clean water in our homes. The drought has strengthened our focus on water. Figure 1 shows the Riverina on 6 November 2002 and Figure 2 is the same scene, ten minutes later—a dust storm. The mouth of the Murray is now closed and we are spending money opening it, but the ocean is running in, rather than the water running out. So nationally, we have an appreciation of this key issue of how we manage our rivers and our water to turn the water to wealth while retaining the health and function of the rivers and of our regional communities.

### We eat a lot of water

Every time one of us eats a good meal, we probably consume five thousand litres of water (Table 1). The water issues of the future hinge on us recognising that the Australian climate is the most variable in the world. We need large storage capacity to deal with that variability and that, in turn, has a great impact on our river flow and flow regimes.

Table 1: We eat a lot of water!

| | |
|---|---|
| 1 cup of lettuce | 11 litres |
| 1 slice of white bread | 28 litres |
| 1 bottle of wine | 360 litres |
| 1 potato | 500 litres |
| 8 oz steak | 4,660 litres |

Standard meal: steak, potato and salad with 2 glasses of wine: approximately 5,000 litres

*Source: Wayne Meyer*

Figure 1: Scene in the Riverina—6 November 2002

Figure 2: The same scene as in Figure 1—only 10 minutes later

Flow regimes and river health are important because without healthy rivers, we do not have quality water. Nutrient and polluting loading is important in our river systems. The salt loading to rivers is a major sustainability issue. Rivers in Western Australia, apart from some in the south-west, are generally salinised already. The story for South Australian rivers is similar. We do not want it repeated in the Murray-Darling. Of course, the salt loading is driven not by irrigation alone; rather, it is driven largely by dryland salinity. To this picture we need to add the effects of climate change. Some of them will become more intractable, others might well become easier, but we need to recognise that climate change could make many of them more difficult.

## Water in Australia

Australia has around four hundred and forty thousand gigalitres of water. The best estimate of how much water can be diverted and turned to human use is about 100,000 gigalitres (Table 2.) At present, we extract about 70,000 gigalitres. We consume about 22,000 gigalitres overall, of which 15,000 is used in agriculture, 1.8 in household sewerage and drainage, and 1.3 in mining and manufacturing. But the consumption in agriculture is increasing—by about 15 percent in the past three years—and we consume 70 percent of the water. We must learn how better to turn that into wealth and wellbeing for our communities.

Table 2: Water in Australia 1993–1997

| | |
|---|---|
| Total run-off | 440,000 Gl (divertible 105,000 Gl) |
| Water extracted | 69,000 Gl |
| Water consumed | 22,000 Gl |
| • agriculture | 15,500 Gl |
| • households | 1,800 Gl |
| • sewerage and drainage | 1,700 Gl |
| • mining and manufacturing | 1,300 Gl |

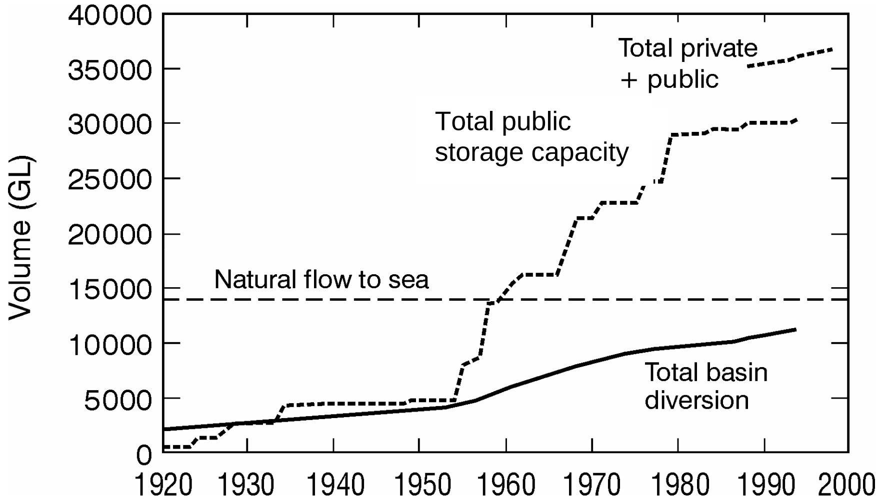
Agriculture consumption increased 15% in 3 years and consumes 70% of water irrigated area—2 million ha.

*Source: ABS 2000*

We irrigate about two million hectares. Irrigated agriculture uses 70 percent of our water but generates 50 percent of our profit from agriculture. That means that from about one percent of the land surface in Australia, we generate much of our agricultural wealth.

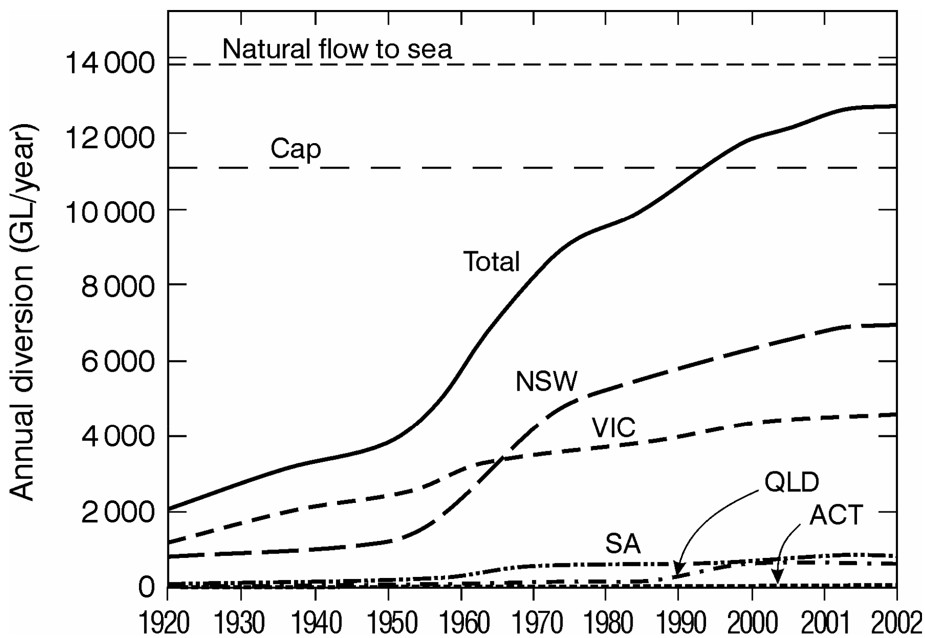
Figure 3 shows the water storage capacity across the Murray-Darling Basin, the natural flow to the sea, and storage capacity in the public and private sectors. We divert about as much water as there is to flow, which is why the mouth of the Murray is closed. The key message is that we have to store water because of climate variability. However, we are storing about 50 percent more than the average flow of all rivers and the carry-over storage is essentially to deal with climate variability. Recognising that, in 1994 we ruled line across the top (Figure 4), which is the actual extraction from our river systems. We call this line the 'cap'. I believe this was the first and most important policy decision in the Murray-Darling, but again, it was only a Murray-Darling issue. Then we said 'OK, the key message is that the available water is heavily used'. But in some instances we have over-used or over-committed water that we do not actually have, so we need to track back through the issue of the relatively small volume left to ensure the river health.

Figure 3: Storage capacity and diversions in the Murray-Darling Basin over time




**Key message**—storage capacity 50% greater than the average flow of all rivers—carryover storages essential to deal with climate variability.

Figure 4: Growth in water use in Murray-darling Basin



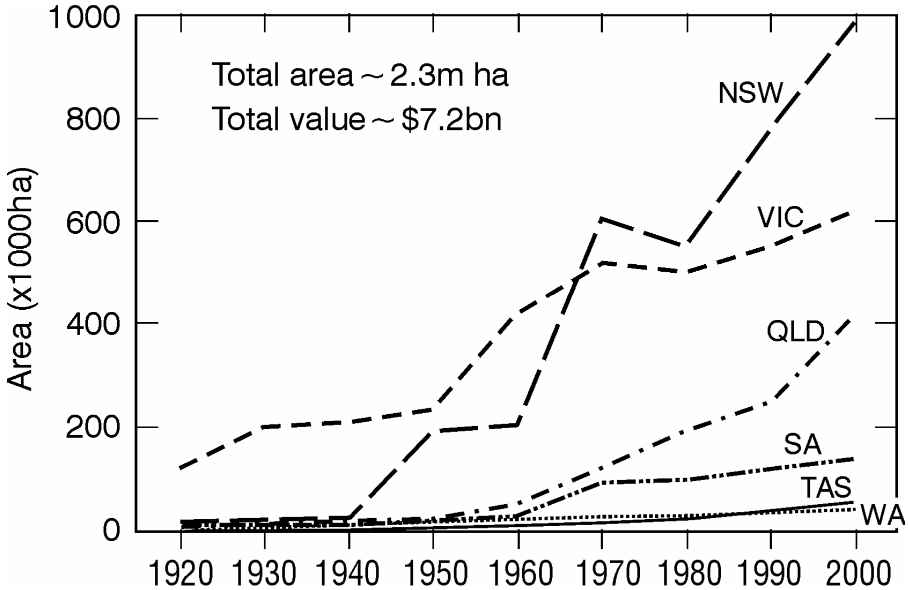

**Key message**—available water is heavily used, leaving a relatively small volume to ensure healthy river

It is clear from Figure 5 that use of irrigation is increasing in each state. The major challenge facing us is water allocation for both extraction and environmental flow for healthy rivers. If we put a cap on surface water, we transfer the pressure to groundwater. We need to deal with them together. You are familiar with the environmental issues: rising water tables; drainage; nutrient loading; and chemical pesticides that we need to keep in the right place and out of our water systems, sumps, estuaries and rivers.

## Water savings

How and where do we achieve these water savings? Is the supply and drainage infrastructure delivering us efficiencies? Clearly it is not. However, if we introduce water trading, we will need to deal with the stranded infrastructure that may well result. Other issues are the small capacity in our very fragmented research effort, and industry leadership in irrigation. Trying to pull the Cooperative Research Centre (CRC) on Irrigated Futures together was very difficult because we do not see ourselves as having an irrigation industry, rather, we see ourselves with a grape industry, a rice industry, a dairy industry and so on. But the tension between water extraction and water flow in the river is a key issue. Water property rights must be addressed because we need research and ways forward to get this right. If we get it wrong, we can do more harm than good.

Figure 5: Development of irrigated areas in Australia



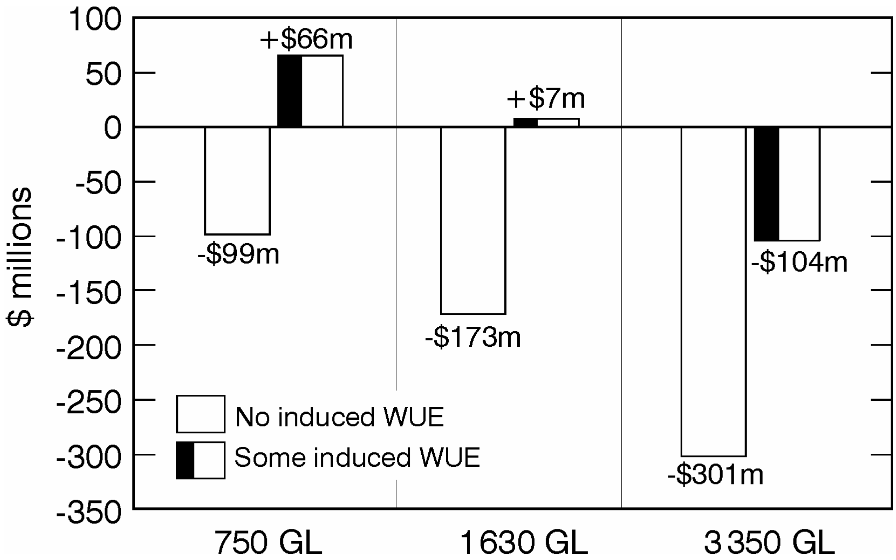

Research to clarify water rights and the obligations associated with them is essential because we must have farmer security as well as the ability to deliver flow. At present, we have a stream in the middle and people pulling both ways. We need to deal with that. This requires something analogous to a Torrens Title that allows us to separate the nature of the tradeable entity in terms of its volume, reliability and probability, from the means of trading. In addition, we need a separate means of regulating the use of that right. These three separate components are essential if we are to achieve the necessary results.

When we try to apply this to the Murray we see that it has a serious problem: to continue to work the river needs more water. Table 3 shows the moderate benefits that experts say might be gained if we were to add volumes of 350, 750 or 1,600 gigalitres to the flow. I think the science under this is not as strong as it should be and that we need much more. A lot more thinking is required and I am delighted to see that we are starting to do that. But whatever amount is needed, it will be large—several times the amount of water used in South Australia.

Table 3: The Murray has a problem to continue to work.
It needs more water—forever

| Additional volume secured for the environment | Expert assessment of likelihood of securing a 'healthy working river' | Percentage of mean volume used in the Southern Connect River Murray System |
|---|---|---|
| 350 GL<br>750 GL<br>1,600 GL | Low<br>Low – moderate<br>Moderate | 100%<br>20%<br>40% |

Figure 6: Aggregate economic consequences of securing water for the Murray




Net present value of changes in agriculture in the economy (ignoring tourism and recreation impacts. Note WUE – Water Use Efficiency)

Figure 6 is an attempt to estimate the net present value of the options. If we take the net present value of changes in agriculture, leave the current infrastructure and agricultural systems in place, and consider the impact of returning the water, the net present value is negative for all of three options.

However, when we add net present values of changes to the economy as a whole, allow that water be traded, new industries to develop and new value to be added to those industries, but we do not take tourism and recreation into consideration, the net present value of returning that water to the Murray is much more tractable. We need to do a lot more work like this—I hope it can be built into the Pratt initiative.

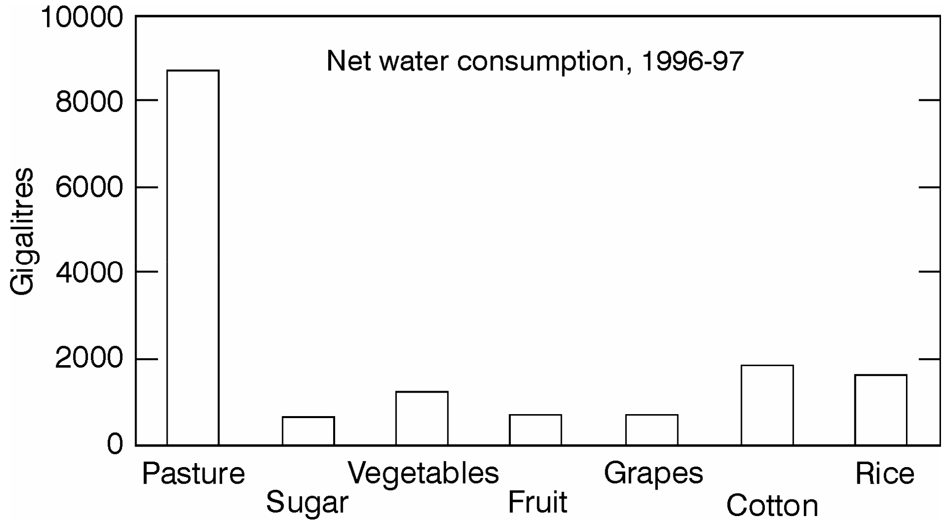
## 2020 vision for forestry

If plantations are placed in the high rainfall zones above 800 millimetres, we might reduce the flows of water into the system by as much as the savings we need, that is, from 500 to 1000 gigalitres. While this is not certain, it is an unresolved issue that needs to be addressed.

The salinity interception schemes in the system essentially waste water: it evaporates, it never goes through a plant, and it does not generate a dollar. The schemes thereby reduce river flows and we need to take that into account. Finally, if we have leaky irrigation systems with return flows to the river, they are probably providing environmental benefit at the moment. If we close them all, we may not improve the system.

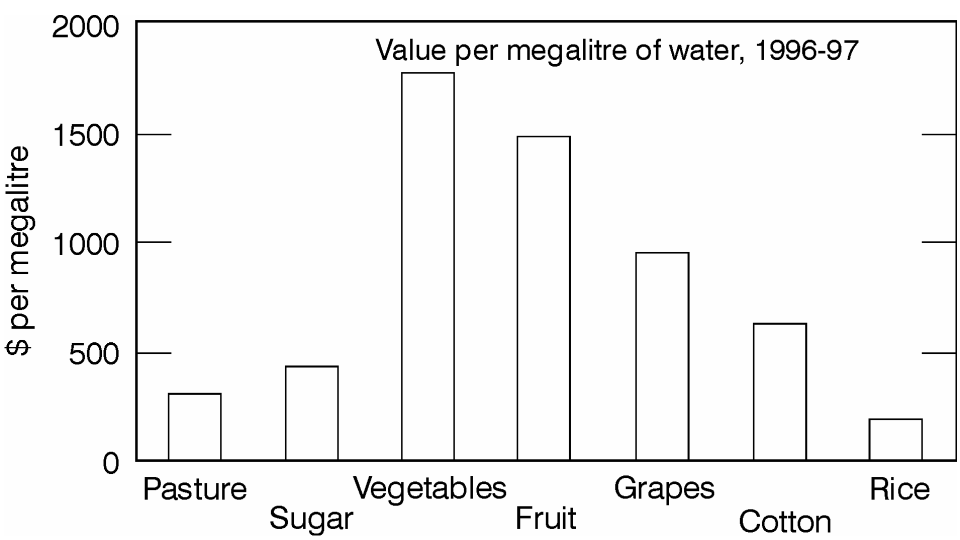
If we look at water consumption in agriculture (Figure 7) we can see that most of our water goes on watering grass. It also goes on vegetables, sugar and fruit. The actual wealth is generated from fruits and vegetables (Figure 8). We need to get the numbers right and as Richard said, we need to make sure we include value adding, to show the actual production costs of the commodity. So the bottom line is that our gross return per unit of water needs to be maximised.

Figure 7: Net water consumption—agriculture




*Source: ABS 2000*

Figure 8: Gross return per unit of water at the farm gate



Our strategy in CSIRO is to convert water to wealth more efficiently while maintaining environmental quality. This is where the focus needs to be. When you look at the sources of water losses in our irrigation systems (Table 4), compare the region, farm gate, on field, in-soil profile and the amount of water that evaporates through the plant. We make our dollars with the 18–26% of the water that goes through the plant. That is the only time we make a dollar. There is enormous capacity to improve efficiency throughout the system. Our effort needs to be in minimising delivery loss and maximising farm efficiencies.

River management issues are important and are inextricably linked to irrigated agriculture. We take water out of the river to make dollars in irrigation; we may leak water back into the drainage system, we affect our wetlands, healthy rivers, estuaries and fisheries—each has a dollar value. But the water in irrigation, rivers, wetlands, and groundwater is one, and we need to treat each element as one system and understand and analyse them accordingly. We need solutions to the whole complex system; we do not want to fix one problem and create two more, which is very easy to do when dealing with systems.

Table 4: Irrigation water losses

| | | |
|---|---|---|
| **Storage** | 100 | |
| Conveyance loss | | Evaporation<br>Leakage, seepage |
| **Regional** | 75 | |
| Distribution loss | | Evaporation<br>Leakage<br>Escape |
| **Farm gate** | 60 | |
| Farm storage and<br>Distribution loss | | Evaporation<br>Leakage |
| **On field** | 50 | |
| Application loss | | Evaporation<br>Surface runoff<br>Leakage |
| **In soil profile** | 36 | Soil evaporation<br>Deep drainage |
| ***Evaporated by plants** | 18 – 26 | |

*Profits are made only when water passes through plants

*Source: adopted from Wolters (1992)*

If we consider the Murray-Darling system, particularly near Griffith, we need to understand how it holds together in terms of climate, geology, hydrology and soils, and how the agronomy and crops mix. But the people, preferences and politics are fundamental. And it is that entire system, not only spatially, which is essential to the way we combine our science and knowledge.

Let us turn to climate variability and climate change. Figure 9 shows the rainfall distribution at Burrinjuck, divided into the periods before and after 1949. The average rainfall at Burrinjuck has increased, and the climate variability has also increased. What is the consequence of such a shift in climate? Figure 10 charts the changes in seasonal flows in the Murrumbidgee at Balranald. It shows the pre-1949 flow regimes, the natural against the actual development which has taken place up to 1994. Post-1949 shows a very different set of flow regimes resulting from the changes in the distribution of rainfall that have occurred over those two intervals.

Figure 9: Climate variability implications for water availability – Distribution of Rainfall at Burrunjuck

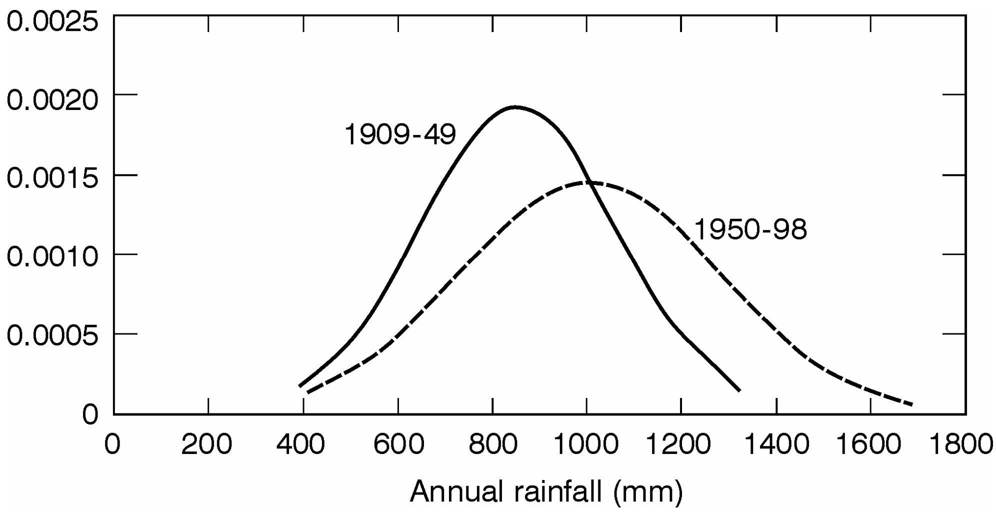
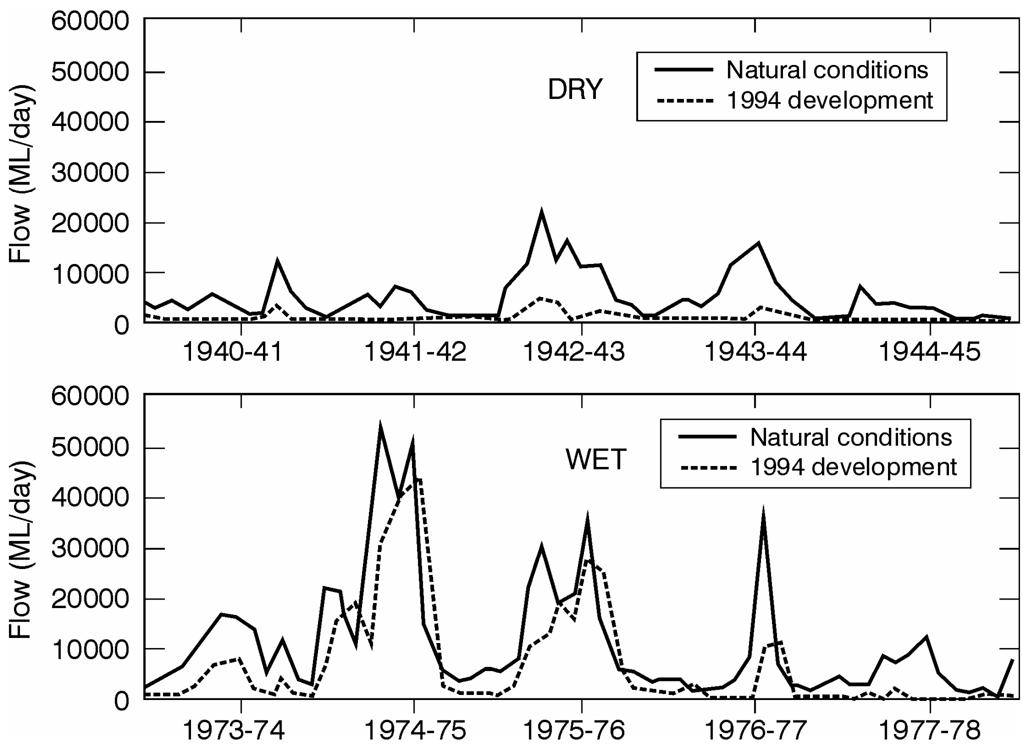



Figure 10: Changes in seasonal flows in Murrumbidgee at Balranald



## Climate change

From the best information we have, we can expect decreases in projected rainfall in some regions of Australia. We see this situation in Western Australia (Figure 11), and a stepping change in the state's reservoir yield (Figure 12). From this we need to appreciate that a 12% reduction in rainfall in this instance leads to a 25% reduction in water yield.

Figure 11: Climate change predictions for rain in Australia

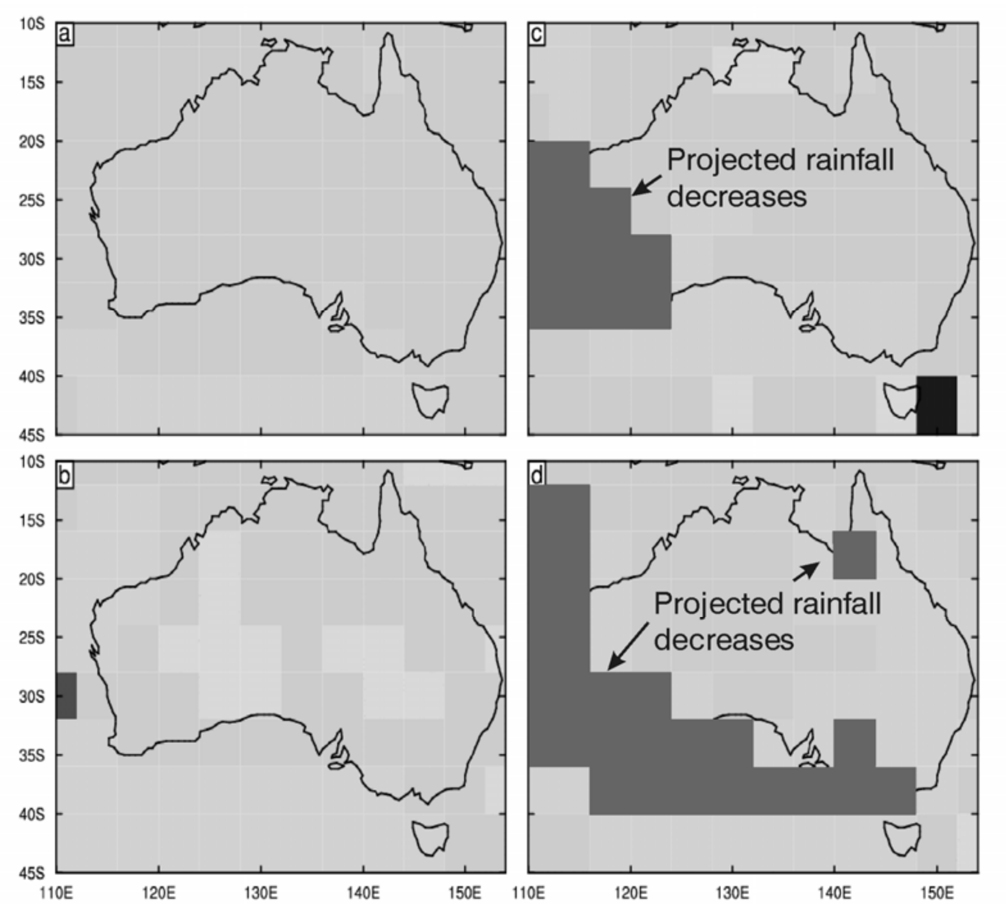
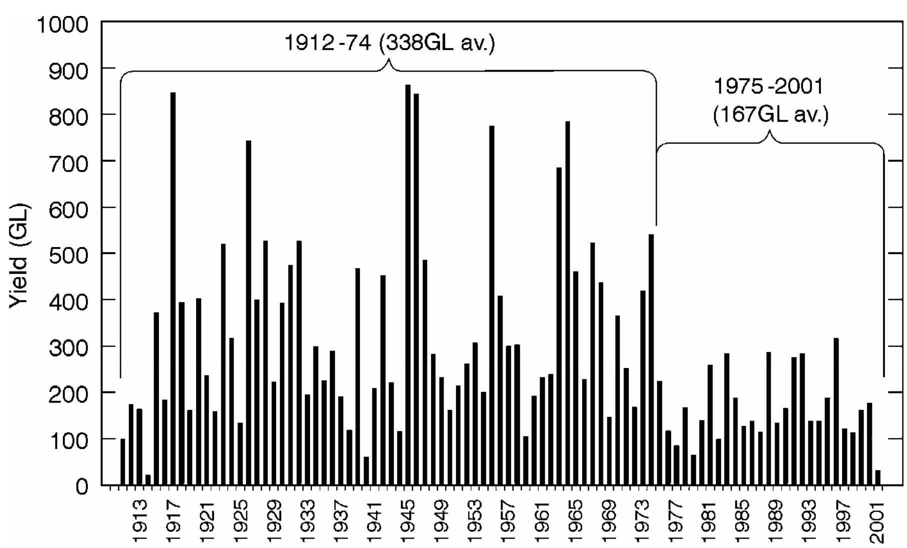



Figure 12: Climate variability: reservoir water yield in Western Australia



## Water futures

The water quality and environmental imperatives in Southern Australia are the growing salinity of our rivers if we do not manage the increasing volumetric production of irrigated commodities. Do we move north, where there is more water for appropriate production systems? This would mean moving to places that are relatively intact and raise a range of ecosystems and hydrological issues.

These big national issues that are the focus of this conference and I think, with John Anderson and Richard Pratt, we have a wonderful foundation for addressing them.

## Acknowledgments

Bryson Bates, Steven Charles, Eddie Campbell, Mark Howden, Bryan Ryan, Wayne Meyer, Shahbaz Khan and Mike Young provided the information I have used, as did my colleagues in the Murray-Darling Basin Commission.

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