MURRAY-DARLING BASIN ROYAL COMMISSION

WITNESS STATEMENT

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Background

1. I am currently employed by the University of Adelaide, where I am a Professor in the Centre for Global Food and Resources and hold its Research Chair in Environmental Water Policy. I was the Founding Executive Director of its Environment Institute. I am also a Fellow of the Academy of Social Sciences in Australia, and a Distinguished Fellow of the Australian Agricultural and Resource Economics Society.

2. My formal academic qualifications include a Bachelor of Agricultural Science (The University of Adelaide, 1974), Bachelor of Economics (The University of Adelaide, 1980), and a Master of Agricultural Science (The University of Adelaide, 1980).

3. I spent 30 years working at the CSIRO: I served as the Chief Research Scientist and Director of CSIRO Land and Water's Policy and Economic Research Unit from 1998 to 2006.

4. I have been closely involved in the development of a range of natural resource and environmental policy reforms, including the development of a NSW government proposal for the introduction of a greenhouse gas emissions trading system in Australia; the introduction of shared fisheries in NSW; Federal involvement in the use of incentives to encourage biodiversity conservation on private land; and the transformation of rangeland management leasing arrangements in the NT, SA and NSW.

5. More recently, I have focussed on water policy reform. My interest and expertise is in developing market-based approaches to the resolution of water scarcity and quality issues. My contribution has been recognised by my receipt of Australia's premier water research prize, the Land and Water Australia Eureka Award for Water Research, in 2006.

6. I have worked with governments across Australia. In the early 2000s, I assisted the South Australian Government to develop a new framework for the management of water in the State's Lower South East. I have also assisted the NSW Government to draft its *Water Management Act 2000* (NSW). I have worked very closely with the Murray-Darling Basin Commission, several Federal Ministers and then the Murray-Darling Basin Authority (**MDBA**) in the lead-up to and preparation of the Basin Plan.

7. As a result of my contributions to the development of water trading and associated sharing and governance arrangements in Australia, I was appointed to the Gough Whitlam and Malcolm Fraser Chair in Australian Studies at Harvard University in 2013/14.

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8. My international experience includes working with the OECD's Environment Directorate to develop a draft framework for the design of water abstraction regimes and options for the management of water scarcity in the Netherlands; leading the water component of a United Nations Environment Program study on 'green growth strategies'; and serving on the Global Water Partnership's Technical Committee. I have recently worked in the U.S. helping to design and bring into effect robust water sharing systems in the Diamond Valley, Nevada and, also, for the management of California's groundwater resources.

9. I have already provided a submission to the Murray-Darling Basin Royal Commission, dated 23 July 2018. The purpose of this statement, which was developed in consultation with Royal Commission Staff, is to expand on some of the ideas and concepts that I identified in that submission.

Context – a future of water scarcity and variability

10. When designing a water sharing system, it is important to understand that we may be facing a future of greater water scarcity and variability. In such conditions, it is critical to ensure that the system structure responds autonomously to changes in the factors that determine how much water is available for use. That is, to ensure that the system's design is dynamic and can be expected to adjust as water supply, use and conditions change.

11. More specifically, we do not know how much it will rain in future and how variable rainfall will be. We do know, for example, in the Murray-Darling Basin, the first half of the twentieth century was significantly drier than the second half. There were long droughts in the 1890s and 1930s. In contrast, the second half of the century experienced large floods and was generally wetter. As a result, there was much more water available in the second half of the century than the first.

12. In addition, climate shifts can be sudden and can be expected to be permanent. I often use the example of what happened in Perth in 1974. In that year, there was a sudden climactic shift and the area appears to have become permanently drier. Since that year, average rainfall has been around 14% less than it was before then and, as a result, inflows have been much, much less. Since 1974, inflows into Perth's main dam have never reached what, on the basis of the preceding seventy years, was thought to be the average inflow.

13. An important lesson from the Perth experience is that the impact of reduced rainfall on run-off can be very severe. The amount of water needed for base flows, which comprises water for conveyance and for the environment, is relatively constant. Therefore, if stream flows below a dam are to be maintained, the amount that can be consumed has to be reduced by much more than the proportional reduction in inflows. This means that the impact of a reduction in mean rainfall trends will be greater than most water users appreciate. In Perth's case, a 14% reduction in rainfall caused more than a 50% reduction in inflows. If base flows are to be maintained then a 10% reduction in mean rainfall can require more like a 70% reduction in consumptive use.

14. These examples demonstrate the challenge of designing water sharing systems based on the historical average water availability and locking in a fixed volume of water that can be consumed in the future.

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Designing 'robust' water allocation systems

15. I specialise in designing robust water sharing systems that can be expected to work well no matter what happens. They are 'robust' because they are designed to work well in extreme circumstances. One of their key features is a capacity to allow for rapid adjustment as conditions change. To design an effective water sharing system, you also need to ensure that allocation and accounting arrangements are consistent with hydraulic processes. That is, the hydraulic system has to have hydrological integrity. The good news is that the basic concepts are relatively simple. Water management is not rocket science, so long as you get the basics right. Sometimes, I say that it is better to be approximately and affordably right than comprehensively wrong or expensively precise.

16. Think of water management as a tank. The volume of water in a system can be divided into three categories. First, there is base flow. Second, there is water that can be shared among users. Finally, there is flood water.

Hands-off flows

17. The first step in designing a water sharing system is to decide what water needs to be left in the system to maintain an adequate flow to supply essential ecosystem services. This is known variously as 'base flow' or conveyance flow. In the United Kingdom, innovatively this water is known as 'hands-off flow'. Even when conditions are dry, the base flow is necessary so that all users can obtain access. As a general, access to this hands-off flow should be contemplated only in extreme conditions.

18. You need to come up with a way to work out the required volume of base flow. For example, it could be expressed as a minimum flow from one reach to the next reach, which would be a certain volume per day that is always required.

Consumptive water entitlements as shares

19. The next step is to determine what water will be available to be shared among consumptive users including the environment. As the challenge is to find the best way to share access to this water pool, the best way to begin is by defining long-term entitlements to access this pool as shares. Shareholders can then be granted shares and guaranteed that access to the pool will always be in proportion to the number of shares held and that no more shares will be issued without simultaneously increasing the size of the resource. Then, allocations are made to the share pool and distributed to shareholders when and as water becomes available for allocation.

20. Defining entitlements as shares makes it clear that access to water cannot be guaranteed. There is no guarantee that those shares will always equate to a certain volume. Instead, rules expressed in a water sharing plan define how much water and when it should be allocated to entitlement holders. Any user can, however, discover the maximum amount that is ever likely to be allocated to them in any time period. Ideally, shares are allocated reach by reach or, in the case of groundwater by aquifer-zone.

21. Announcements as to how much water is to be allocated need to be made in a disciplined manner so that there are no opportunities for insider trading.

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22. Once shares have been allocated and issued to users, investment security is achieved by legislating that no Government or Minister can issue more shares unless they bring more water permanently into the system.

23. Many well-designed systems partition shares into at least two or three priority classes. Across the Murray Darling Basin, for example, you can find high priority, medium priority and low priority shares. High priority shareholders can expect to receive the maximum allocation volume per share in almost every year; medium priority shareholders can expect to receive their full allocation in, say, eight out of 10 years; and low priority shareholders can expect to receive their full allocation in, say, five out of 10 years.

Flood water

24. The last part of the system that can be usefully be thought of as a tank is the floodwater located at the top of the tank and which has a bad habit of spilling over the bank. In the Murray-Darling Basin, this water that sits above what is known, at a sub-system level, as the Sustainable Diversion Limit and across the entire Basin as the Basin Diversion Limit. Conventionally, no entitlements to this flood water are issued and, as a result, nobody is liable for the harm flood water does to property. This water, however, is very important and plays a major role in the delivery of environmental benefits. In some areas, capture of this water is allowed and in others, it is left to flow through the system.

Water Accounting

25. The Basin Plan sets sustainable diversion limits in a rigorous manner but can be criticized because these limits are not defined in a manner that is dynamic. When the Basin Plan was being developed, I tried to convince the Authority to include a mechanism that would allow ongoing adjustment of the these limits. Legislators, however, decided to only allow adjustment until June 2024 and only for efficiency measures.

26. To design a water sharing system with hydrological integrity, is it important to understand the difference between net and gross water accounting.

27. In gross sharing systems, water allocations are specified as an authorisation to take and use a volume of water without regard to the portion of it that returns to the river or aquifer (known as 'return flows'). Net sharing systems take account of return flows and, using estimates contained in water sharing plans, assumptions are made about the proportion of water that is returned following use.

28. The Basin Plan as currently drafted appears to have adopted a gross accounting system. This means that, for example, the 2,750GL recovery volume does not take into account changes in return flows as a result for example of a decision to convert from flood to drip irrigation. No account also seems to have been taken of the impact of water use efficiency across much of the Basin. In recent years, for example, there has been a considerable increase in the area planted to almonds. While I have not done the studies, I suspect that the majority of the water used to grow almonds under drip irrigation will come from land that previously was used to flood irrigate pasture.

29. Less return flow means that less water is available either elsewhere in the system from which it was taken or from the groundwater system it is connected to. That is, as the irrigation

industry develops technology to increase the technical efficiency of irrigation, the result is a reduction in the amount of water that is available to others. Unless the gross volume that a person is allowed to take is reduced as water-use efficiency is increased, the net amount of water taken must be expected to increase unless the allocation rules in the Basin Plan are written in a manner that makes it clear that as one person makes more efficient use someone else has to reduce use. Increasing the technical efficiency of water use does not necessarily 'save' water'.

30. There are two ways of dealing with this issue in a robust manner. Option 1 is to reduce each SDL as the technical efficiency of water use increases and legislate a hands off flow. Option 2 is to account for water use using a net accounting system. In the past, the latter option has been expensive to administer and tends to dramatically increase the costs of water trading. This latter approach, however, is used in much of western USA. Advances in remote sensing techniques, however, are making this approach affordable. Groundwater users in California are giving this approach careful consideration – especially in places where meters have yet to be installed.

31. The return flow issue has been discussed in numerous publications I have contributed to.

32. A CSIRO Land and Water report by Brett Bryan and Steve Marvanek titled '*Quantifying and valuing land use change for Integrated Catchment Management evaluation in the Murray-Darling Basin 1996/7 – 2000/01: Stage 2 Report to the Murray-Darling Basin Commission*' investigated the change in water use in the first five years following the introduction of the 1993/94 Cap on diversions (**the Cap**). It included results from a National Land and Water Resources Audit that I developed, which used satellite imagery to estimate water use in the Basin. It looked like there was around a 20% increase in the area of irrigated agriculture from 1996/97 to 2000/01. The report used modelling to estimate that this resulted in a similar increase in total irrigation water requirements. During that time, the Cap was not being exceeded. It was working *in gross*. However, lots of people had started using groundwater and surface water more efficiently, which were likely to reduce return flows, and none of those lags in the system had been factored into the Cap modelling.

33. I also wrote a report with Jim McColl in 2003 titled '*Robust Reform: Implementing robust institutional arrangements to achieve efficient water use in Australia*'. We looked into what would happen if we took 1,500GL away from irrigators without compensation (e.g. dropping the SDL by 1,500GL). We found that water use would actually increase by around 2,100GL, so the Basin would be around 600GL worse off. This is because farmers would innovate. They would start using groundwater. They would change their irrigation practices by re-lining their farm channels so that water that used to drain into the river would instead drain into their storages. They would find ways to save the previously 'wasted' water. (These are all things that ended up happening.) I was also worried about there being increases in forestry in the south-east and more investment in capturing overland flows. If you add it all up, it would be a net loss.

34. At the time, I went to Wendy Craik to share these observations as she was the Chief Executive Officer of the Murray-Darling Basin Commission. Having carefully considered the implications of what I was saying she said something like "You're right, but we've got to let this happen. We've got to get the irrigation community used to transfer water to the environment. The issue you raise is too complicated. What you're saying is politically too

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hard. We just need to start the journey and work out how to manage the consequences of the issue you raise at a later date."

35. Before leaving this issue I need to acknowledge that in the last few months and as a result of ongoing criticism of Basin Plan implementation and the effectiveness of Federal Government investments in so-called efficiency projects, the Murray-Darling Basin Authority has started to consider the return flow issue as it is required to do under the Water Act. This legislation says, amongst other things:

> **s. 10.12 Matters relating to accounting for water**
>
> (1) For paragraph 10.10(3)(a), the following matters must be accounted for:
>
> (a) all forms of take from the SDL resource unit and all classes of water access right;
>
> (b) water allocations that are determined in one water accounting period and used in another, including water allocations that are carried over from one water accounting period to the next;
>
> **(c) for a surface water SDL resource unit—return flows, in a way that is consistent with arrangements under the Agreement immediately before the commencement of the Basin Plan;**

A dynamic system

36. As I set out in my submission, state of the art in the design of resource management systems is to make them as dynamic as possible and to include in the system mechanisms that adjust automatically. One of the most obvious is to include a mechanism that adjusts automatically for factors that are not part of the formal accounting system. As a Professor of Business Accounting once explained to me, most water accounting systems are back to front and start at the wrong end. If you want to know how well a system is being managed, hard wire the allocations to system to flows out the mouth of a river in the same way that corporations have to focus on profits. If this was done then SDL adjustment would be automatic and any unaccounted for change in net water use automatically adjusted for.

Conclusion

37. My overall message is simple: the fundamental structure of the Basin Plan is very close to state of the art in the management of scarce water resources. The challenge now is to get the detail right and put in place arrangements that ensure that the investment Australia is making gets the detail right. Some of the accounting flaws are serious and need urgent attention.

38. As I observed in 2014, the amount of money being invested is massive. In 2014, there were 14,340 surface and groundwater users in the entire Murray Darling Basin. If you divide the amount being invested by the number of water irrigation businesses in the Basin, the amount comes to around $750,000 per irrigation business.

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