Integrated groundwater and surface water management: Prospects for underground water storage and water banking

Submission by Dr Andrew Ross to Productivity Commission inquiry into National Water Reform

Summary

Integrated groundwater and surface water management involves the combination of groundwater, surface water and/or additional sources of water over wet and dry periods to achieve public policy and management goals. One important technique for integrating groundwater and surface water management is banking water underground in wet periods and bringing it up for use in dry periods. Underground water banking brings a number of benefits, including greater water supply security and stability, increased water system efficiency and maintenance of water quality. Despite these benefits there are relatively few examples of underground water banking in Australia compared to other dry regions such as the Western USA, Spain and India, and Australian schemes are relatively small scale. Investment in underground water banking is discouraged by institutional settings that encourage surface water capture and storage, and disincentives to underground storage including short carryover periods and lack of secure entitlements to recover water stored underground. Water storage is an important but neglected element in Australian water reform. Intervention and leadership from governments is necessary to offset or remove disincentives to underground water storage and water banking and to unlock investment. Governments could take a number of actions including:

- an inter jurisdictional review of opportunities for integrated management of groundwater and surface water over wet and dry periods including underground water storage and water banking;
- consideration during the implementation of the Murray-Darling Basin plan of catchment water planning rules that enable integrated water management over wet and dry periods; and
- establishment of a national scheme to fund selected state based proposals for underground water storage and banking.

Introduction

Integrated groundwater and surface water management involves the combined use of groundwater, surface water and additional sources of water through wet and dry periods to achieve public policy and management goals. Integrated groundwater and surface water management brings a number of benefits. In 2014 the National Water Commission (NWC 2014 - see Attachment 1) proposed that the integrated management of multiple sources of water can:

- improve security and reliability of supply and resilience to climate change by using surplus surface water such as dam spills and floodwater to recharge aquifers when water is plentiful and drawing water from aquifer storage when surface water is scarce (Evans and Evans 2012, Ross 2017);
- manage cross impacts of groundwater and surface water use on other resources and the environment. This can counteract waterlogging, drying wetlands and salinisation, excessive river flow depletion and overexploitation of aquifers (Winter et al 1998, Evans 2007) and reduce risks from mosquitoes and algae. If impacts cannot be avoided integrated water management can reduce the impact by transferring or sharing impacts across systems and deferring impacts through time or distributing them over a wider area;

- enable acceptable levels of water quality by mixing different water sources, combining water treatment with enhanced recharge, leaching and diluting pollutants and controlling seawater intrusion (Dillon et al 2009);
- improve water system efficiency and resource conservation by compensating for shortfalls in water availability at critical times for crops and water dependent ecosystems (Evans and Evans 2012);
- store water when and where it is needed. Aquifers can be used to store water to smooth daily variation in urban water demand and seasonal variation in irrigation demand.

The benefits of integrated groundwater and surface water management are well established and agreed internationally but progress towards the implementation of integrated water management in Australia and elsewhere has been relatively slow because of significant institutional and political barriers (GGGFA 2015, NWC 2014).

In the remainder of this submission I briefly examine prospects for underground water storage and water banking, which are important techniques for combining multiple water sources to achieve water supply security and stability, and acceptable water quality through wet and dry periods. I am attaching copies of my recent journal article "Speeding the transition towards integrated groundwater and surface water management in Australia" (Attachment 2), and my PhD (Attachment 3) which provide further details to support my submission.

Prospects for underground water storage and water banking

Many areas in Australia are subject to highly variable water supplies and water scarcities. Dams have already been built in the most suitable locations in Australia, and many reservoirs are shallow and have high evaporation rates. During the millennium drought water storages in the Murray–Darling Basin fell below 25% of capacity for extended periods. Banking water in aquifers during wet periods and recovering it during dry periods is one solution to Australia's boom bust water cycle. Over 3000 gigalitres (GL) evaporates per year from surface water storages in the Murray-Darling Basin. If only 10% of this is saved by banking water underground the gross value is estimated at $300 - $600 million. Desalination plants are a very costly alternative.

Underground water banking requires surplus water and infiltration of water to an aquifer suitable for storage and with available storage space. These conditions exist in many populated regions of Australia. Underground water banking may involve small reductions in groundwater allocations in wet years, changes in land use practice to encourage water infiltration, and/or managed aquifer recharge using in-channel devices or off channel basins and injection wells. In this context the impact of more efficient irrigation on aquifer recharge needs to be accounted for (Ross 2014, 2017).

The potential of underground water banking is shown by what is already being done. 45GL of water is being stored in aquifers in the Burdekin region of Queensland every year – for use in agriculture and horticulture. Significant quantities of recycled stormwater and wastewater are being stored in aquifers and used around Adelaide. In Perth a $125M Groundwater Replenishment Scheme is currently under construction to recharge 14 GL of water annually. But water banking is at a small scale compared to overseas examples. In Orange County California one water bank holds around 300 GL a year – enough for the annual household use of 2.3 million people. The Semitropic water bank in central California has held up to 800 GL for its members and the Arizona water bank up to 1600GL.

Integrated management of surface water and groundwater is an objective of Australia**’s** 2004 National Water Initiative, but there is still little or no systematic attempt to plan and manage groundwater and surface water storage and use at a regional scale over time. Institutional settings encourage water storage in dams and reservoirs. The costs of evaporation and environmental impacts of dams are not accounted for and agricultural water users do not pay the full cost of surface water storage and delivery (Ross 2017). Political preferences strongly favour investment in surface water dams. Water storage is an important but neglected element in national water reform.

The encouragement of surface water storage (reservoirs and farm dams) and the lack of accounting or payment for evaporative losses from these storages are indirect but powerful disincentives to investment in underground water storage. There are two more direct disincentives.

- Firstly, water stored in an aquifer becomes part of the groundwater consumptive pool and does not automatically attract a high security recovery right. Under current arrangements, most users have no guarantee that they can recover water that they store underground. Legislated rules need to be developed to allow for storage, recovery after storage and losses during storage and recovery, to enable under groundwater storage and water banking. A possible framework was suggested in Dillon et al. 2012.
- Secondly, carryover is subject to a range of limits in different jurisdictions. Short carryover periods (usually not more than three years) restrict flexibility for users to store water underground as a drought reserve. Extended carryover to allow water users to use groundwater and surface water flexibly over wet and dry climate cycles can smooth irregularities in water supply and allow increased total consumption of water without breaching sustainable groundwater use limits (Ross 2012 p 280-281).

Interviews with government water managers and water users indicate that while the theoretical benefits of underground water storage are well understood governments are preoccupied with other elements of the NWI and Murray-Darling Basin plan such as the balance between consumptive and environmental water. Water users comment that while they recognise the benefit of underground storage, under the current regime they have no incentive to invest. This means that neither governments nor users are likely to push for integrated groundwater and surface water management across wet and dry cycles without advocacy and leadership from third parties such as individual champions, research agencies and NGOs. However, leadership from governments is also required to offset or remove disincentives to investment.

Recommended action

The potential water saving benefits of integrated groundwater and surface water management are comparable to the supply options and irrigation efficiencies which are being considered under the Murray-Darling Basin Plan. Additional policy intervention is needed to spur action to realise the benefits of integrated groundwater and surface water management across wet and dry periods and to overcome disincentives to underground water banking.

- As a first step the Commonwealth government could initiate an interjurisdictional process to further examine the opportunities and barriers for integrated groundwater and surface water management over wet and dry periods including underground water storage and water banking. The last interjurisdictional process to examine integrated groundwater and surface water management took place in 2004 (Fullagar 2004, Brodie et al 2007).

- The Murray-Darling Basin Authority could initiate a study of the benefits and costs of integrated groundwater and surface water management over wet and dry periods, and the development of catchment water planning rules that enable integrated long-term management of groundwater and surface water including water banking.
- Finally the Commonwealth government could seek proposals from State governments and water users for underground water storage and water banking projects that would improve water supplies across wet and dry periods. These could be co-funded by the Commonwealth and the States.

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