AUSTRALIAN WATER ASSOCIATION

Large Dams

Fact Sheet

What is a dam?

Dams are built to control and store water. Dams are made from earth, stacked rock or concrete, and are usually constructed across rivers to store water in the reservoir that is formed behind the dam as a result of the river being blocked.

The International Commission on Large Dams (ICOLD) defines a dam as 'an artificial barrier that has the ability to impound water, wastewater, or any liquid-borne material, for the purpose of storage or control of water'.

Dams vary immensely in size and shape, from small farm dams that hold water for stock watering, to large dams which store water for large urban centres. This technical fact sheet is aimed mainly at large dams.

Photo: Hinze Dam Alliance

Definition of large dam

The International Commission on Large Dams defines a large dam as one which is:

a) More than 15 metres in height measured from the lowest point of the general foundations to the crest of the dam,
b) More than 10 metres in height measured as in (a) provided they comply with at least one of the following conditions:
   i. The crest is not less than 500 metres in length
   ii. The capacity of the reservoir formed by the dam is not less than 1 million cubic metres
   iii. The maximum flood discharge dealt with by the dam is not less than 2000 cubic metres per second
   iv. The dam is of unusual design

Dams in Australia

Australia is the driest inhabited continent and has the highest per capita surface water storage capacity of any country in the world. The large number and size of water storages is a function of both Australia's aridity and the highly variable rainfall. Australia can be divided into either states and territories, or hydrological regions called drainage divisions. There are 310 storages in Australia with a total capacity of 80 957 805 ML. Table 1 provides a summary of the main water storages for each capital city in Australia.

Table 1: Summary of the main water storages for each Australian capital city

Capital City	Number of storages	Capacity	Description
Adelaide	10	197,405ML	Adelaide is located in the South Australian Gulf drainage division. Water is harvested from several sources including the River Murray and runoff from the Mount Lofty Ranges. Adelaide relies on the River Murray for about 40 per cent of its water needs in a normal rainfall year, and as much as 90 per cent in a dry year. The system of storages which supply Adelaide are owned and operated by SA Water.
Brisbane	12	2,220,150ML	Brisbane is located in the North East Coast drainage division. The SEQ Water Grid connects many major storages in South East Queensland via a network of water treatment plants and two-way pipes that move water between sources across the region. From the eleventh of June 2010, twelve key water storages, operated by SeqWater, are used to calculate Brisbane's capacity. Prior to this only the three largest water storages; Wivehoe, Somerset and North Pine were used.
Canberra	4	277,839ML	Canberra is located in the Murray-Darling drainage division. Canberra draws its water supply from large surface water storages. Water is harvested from the Cotter River and the Murrumbidgee River (within the ACT) and the Queanbeyan River via Googong reservoir (in NSW). The storages in Canberra's water supply system are owned and operated by ACTEW Corporation Limited.
Darwin	1	285,450ML	Darwin is located in the Timor Sea drainage division. The Darwin River Dam is the principal water supply for Darwin. Its upstream catchment area is completely protected (a "closed catchment") providing excellent water quality for Darwin and a safe refuge for many rare and endangered plants and animals. Power and Water is responsible for providing water supplies to Darwin from combined groundwater and surface water sources. Construction on the Darwin River Dam was undertaken during 2009 and 2010 to raise the spill-way and increase the storage capacity available for Darwin.
Hobart	1	3,600ML	Hobart is located in the Tasmanian drainage division. In contrast to most Australian cities, the majority of Hobart's water supply is sourced directly from rivers, principally the Derwent River. Bulk water supply to Hobart, including the operation of storages, is managed by TasWater.
Melbourne	10	1,812,175ML	Melbourne is is located in the South-East Coast drainage division. Around 80% of Melbourne's drinking water comes from closed water catchments in the Yarra Ranges. For over 100 years 1,570 square kilometres of forest has been closed to the public. The stor-ages in Melbourne's water supply system are owned and operated by Melbourne Water.
Perth	11	580,795ML	Perth is located in the South West Coast drainage division. Perth's potable water is supplied from the Integrated Water Supply Scheme. Surface water storages contribute about one-third of the supply. Groundwater and desalinated sea water supply the rest. Water Corporation manages the Integrated Water Supply Scheme, including the system of storages which supply Perth.
Sydney	15	2,581,850ML	Sydney is located in the South-East Coast drainage division. Drinking water for Sydney is collected from five primary catchment areas with a total area of approximately 16,000 square kilometres. Of this area, more than half is harvested by Warragamba Dam (Lake Burragorang), one of the largest domestic water supply storages in the world. The storages in Sydney's water supply system are owned are operated by Sydney Catchment Authority.

Source: BOM, http://water.bom.gov.au/waterstorage/awris/

How do dams work?

Dams store water in the reservoir formed behind the dam. The stored water can be used for various consumptive purposes, including use as water for irrigation, or as sources of drinking water for urban and regional towns and cities. The stored water can also be released from the reservoir during the times that natural flows in downstream rivers are inadequate to help meet a variety of environmental objectives. Depending on the catchment area for the dam, the water stored in dam reservoirs is usually easier to treat to a drinking water standard than other sources of drinking water, such as run of river supplies. This is because the long time spent in storage usually improves the quality of the water stored in the reservoir.

How many dams are there in Australia?

There are more than 820 major dams on waterways in in Australia, with a total capacity greater than 91 000 GL (Tom Rayner, The Conversation). As Rayner notes, most of these dams are at southern latitudes, where Mediterranean climates mean there is a need to store water to last through Australia's dry summers. Less than 10% of these dams are located in northern Australia. Of these 820 dams, 500 are considered 'large dams'. A register of Australia's Large Dams in Australia, up to 2010, can be found at http://www.ancold.org.au/?page_id=24

What are the benefits of dams?

Water supply for domestic, irrigation and industrial use

Dams can provide a cost-effective supply of water for domestic, irrigation and industrial use, when compared to other sources of water, such as recycled water, groundwater, desalination and demand management on a cost-benefit analysis. When determining the suitability of dams all water source options should be assessed based on a cost-benefit analysis.

Meeting the agricultural demand for food supply

The water stored in dams is critically important to many towns in rural and regional Australia, as they are often the main source of water supply. The dams have enabled many regional and rural towns to prosper and develop economically-important agricultural industries. The 2014 Agricultural Competiveness Green Paper identifies 27 potential new dam sites in Australia that would help develop new food growing regions.

Flood control

Whilst not always their primary purpose, dams provide the opportunity to attenuate flood flows, by their ability to store large volumes of water and then constrain the rate of outflow to downstream rivers through spillways or other release structures.

Hydropower

Hydroelectricity is electrical energy generated when water that flows down rivers, streams or waterfalls is channelled through water turbines. In Australia, hydroelectric power is most commonly generated from water is that is stored in dams and then released from the dam through water turbines In 2011, hydroelectricity produced 67 per cent of Australia's total clean energy generation.

Recreation

Dams provide opportunities for communities to undertake various recreational activities, such as sailing, boating and fishing. From a public health perspective it is highly preferable if this onwater recreational activity occurs on dams that store water that is not going to be used as a source of drinking water.

Dams can also promote local tourism.

Costs of dams?

While dams are generally the cheapest source of bulk water, their construction can have significant upfront costs and environmental costs. In the Australian environment, dams lose large volumes of stored water through high rates of evaporation (particularly in summer) and possible seepage. The relative cost differences between dams and other sources of water supply, such as desalination, are magnified because most large dams were built and partially paid for many years ago. Current water users have been receiving cheap water from the old infrastructure paid for by prior generations but are now paying for the 'spike' in costs associated with renewal and capital upgrades. These costs will to some extent equalise over time.

Environmental consequences

There are numerous and varied environmental consequences associated with dams which include direct impacts to the biological, chemical and physical properties of rivers and riparian environments. International Rivers lists the following potential environmental consequences of damming rivers:

- Direct impacts to the biological, chemical and physical properties of rivers and riparian (or "stream-side") environments
- Dam walls blocks fish migrations, which in some cases, and with some species, completely separates spawning habitats from rearing habitats
- Dams trap sediments, which are critical for maintaining physical processes and habitats downstream of the dam
- The transformation of the upstream catchment area of the dam, from a free-flowing river, to an artificial slack-water reservoir habitat, which can lead to changes in temperature, chemical composition, dissolved oxygen levels and the physical properties of a reservoir
- Reservoirs can host non-native and invasive species, such as snails, algae and predatory fish
- Disrupted and altered flow of rivers, above and below the dam wall, which can cause sustained impacts to aquatic and terrestrial life in and around the rivers as the timing and quantities of river flow are altered

Dams and climate risk

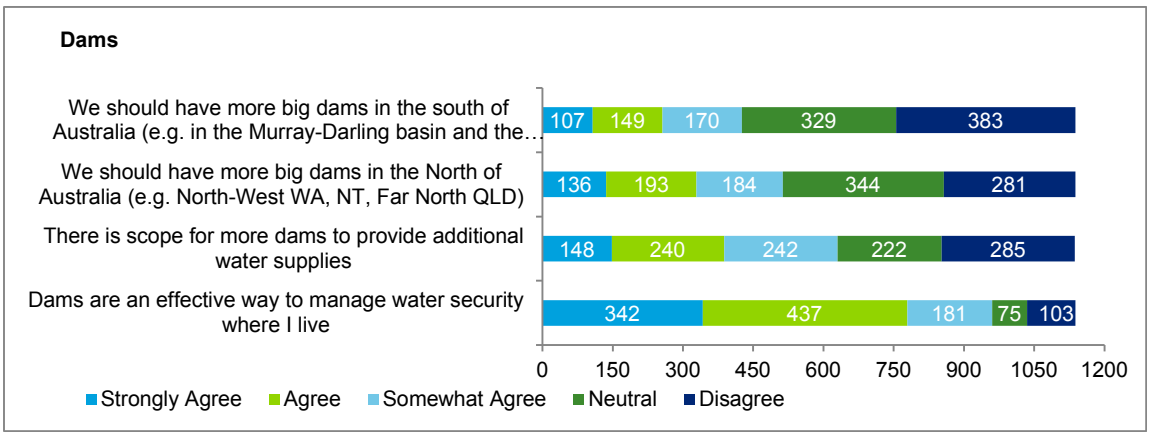
There is a complex relationship between climate, weather, rainfall and stream flows into dams. The proportion of total rainfall from heavy falls will increase in the 21st century over many areas of the globe. A one-in-twenty year maximum daily rainfall event is likely to become a one-in-five to one-in-fifteen year event by the end of the 21st century in many regions. According to the Climate Commission the south west of Australia has experienced a step change in its rainfall and stream flow patterns. The long-term drying trend evident from the mid-1970s places this area and the city of Perth in a position where it is unlikely that any new dams will ever be built.

Ensuring secure water supplies

In the face of growing challenges of climate and population growth the whole portfolio of supply augmentation and demand management options should be assessed. Good, robust collaborative planning and discussion between the water industry, regulators and communities is also required to come up with the best mix of water supply options, one of which may be the construction of new dams. Smart solutions to manage water and on-farm drought should be utilised, such as through better crop varieties, more efficient water application, smarter irrigation layout, better on-farm data collection and interpretation and a greater investment in education and training.

The AWA/Deloitte State of the Water Sector Report 2014, gauged water sector professionals' views on dams and their impact on ensuring water security. Eight-four per cent of respondents to the survey that fed into the Report at least 'somewhat agreed' that dams are an effective method for managing water security within their region, and 55% of respondents felt that there is scope for more dams to be built.

Figure 1: Dams as a means to ensure secure water supplies



Source: AWA/Deloitte State of the Water Sector Report 2014, pg 22, http://www.awa.asn.au/uploadedfiles/State_of_the_Water_Sector_Report_2014_FINAL.pdf

For more information on dams in Australia

Australian National Committee on Large Dams Incorporated,
http://www.ancold.org.au/

International Commission on Large Dams
http://www.icold-cigb.org/

Dams Safety Committee, NSW
http://www.damsafety.nsw.gov.au/default.htm

University of Queensland, UQ News
http://www.uq.edu.au/news/article/2014/10/dam-hard-water-storage-historic-headache-australia

For an overview of dams, ICOLD, Dams and World Water International Rivers
http://www.internationalrivers.org/