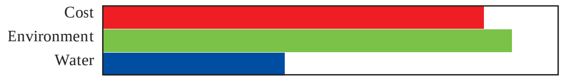
Install a rainwater tank



Rainwater tanks have a long history of use for domestic water in Australia. Many can recall going to their grandparent's house and drinking pure water 'straight from the sky' from the rainwater tank out the back. When they started disappearing, it was because of bird droppings from the roof and pollution that would get into the water. New rainwater tanks are now on the comeback, being introduced into towns and urban areas in order to conserve tap water supplies.

Tanks in all shapes, sizes, colours and materials to suit the home and garden have now superseded the old 'garden variety' of a rusty corrugated iron tank. The pre-fabricated varieties currently come in sizes up to 50,000 litres, though concrete and brick tanks can be built to any size.

Over 3 million Australians currently use rainwater from tanks for drinking (ABS, 1994 cited in SIA, 2002). In many parts of rural and regional Australia, and in some fringe areas without access to mains water supply, rainwater tanks are essential to collect water for household use.

Rainwater tanks are used to supplement the centralised water supply and are generally recommended for garden watering, car washing, toilet flushing and washing machine use, and with correct design for drinking water. They also provide benefits to the community by reducing stormwater runoff. Rainwater tanks used for household purposes are generally topped up by mains water in dry periods. A backflow prevention device is installed to prevent cross contamination with the mains water supply.

Some Councils and water authorities in Australia are currently offering rebates to help with the costs of installing rainwater tanks, or have development controls which require the installation of rainwater tanks in urban areas. See *In the Home and Garden* for more information on rebates.

Rainwater tanks are one approach to integrating management and conservation of the water cycle as a whole, which people are calling 'Water Sensitive Urban Design'.

figure 44 - Jill Luhrs of Wavell Heights with her rainwater tank (News Ltd)

Issues

Water for our urban areas is treated to drinking water standard despite the fact that only a small amount is used for drinking. Studies in Victoria have shown that using rainwater tanks across the state to water the garden would reduce demand on mains by 25% (Vic Govt, 2002a).

Rainwater tanks have a small footprint, designed to fit into existing house designs, and easily into new housing developments.

Water quality concerns have long delayed the widespread use of rainwater tanks. New tanks now contain design aspects that ensure the water is safe from contamination but require sensible maintenance of the rainwater tank and catchment area. First flush or filter socks are installed to discard or filter the initial flow of water from the roof, which may contain contaminants such as leaves, air borne pollutants and animal droppings.

Water filtration devices and litter proofing measures are encouraged. Mesh screens are installed over all inlets and outlets to prevent leaves, debris and mosquitoes from entering the tank. Gutters should be cleared every 3 months to 6 months of leaves and debris. Collection of rainwater for human

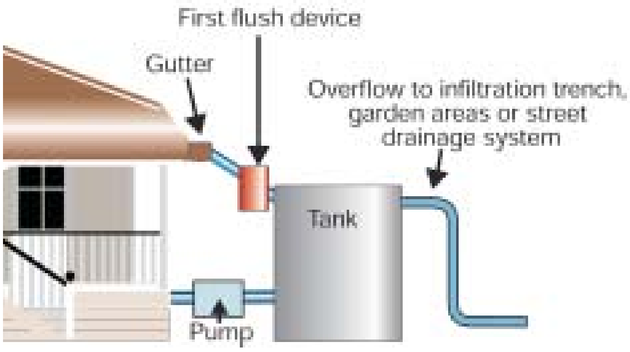


figure 45 - Typical tank connection
(Michelle Kiejda, adapted by News Ltd)

consumption in areas affected by heavy traffic or industry is not recommended (Cunliffe, 1998).

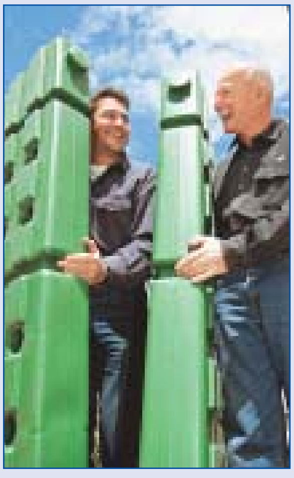
The installation of rainwater tanks can reduce the amount of stormwater runoff that can cause local erosion and flooding and reduce the damage to local streams and beaches, drain infrastructure and roads during small to medium storms. Rainwater tanks have the added advantage of collecting runoff in summer storms in droughts whereas a dry catchment would not receive runoff under such storms.

Rainwater tanks are more suitable to areas that have a consistent rainfall pattern which allows the rainwater tank to be topped up constantly and in areas that are away from air emission industries and dust generation. If just 1% of the homes in Metropolitan Melbourne installed a 2,250 litre water tank, over 70 million litres of water could be saved each year (Vic Govt, 2002b).

The additional benefits of rainwater tanks beyond just supplying water needs to be considered. The WA Water Corporation has noted that due to seasonal precipitation in WA and the ongoing maintenance costs, the cost of water from a rainwater tank would cost about $8 per kL (Hanley, 2002).

Rainwater Tank Fence

An Australian company has come up with a great idea - a rainwater tank that can be a fence or a garden shed. Moulded in polyethylene and only 190mm thick (less than eight inches), the tanks are modular so they can be fitted together in series. There is no limit to the number of modules that can be connected to one another.
(Freewater Modular Systems)



News Ltd

figure 46 - Lyn Patrick, Berni and Jesse Hockings from Newcastle display their new rainwater tanks
(Michael Osborne)

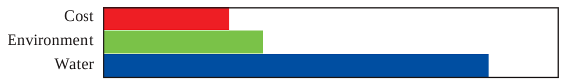
Rainwater tanks can delay the need for expensive upgrading of infrastructure in a centralised water supply system. A study by Dr George Kuczera has found that the use of water tanks in new housing developments on the NSW Central Coast area would delay the need for new water supply infrastructure for a century, and that for Newcastle the delay would be about 10 years representing a saving of about $110 million to $120 million (Kuczera, 2001).

Importantly, the savings on mains water will ultimately mean saving to the consumers. It is estimated that domestic water users can save as much as 40% of mains water use by using a rainwater tank. In Sydney, where the price of water is just under $1 per kL, this would mean a saving of around $150 per year on water bills for a household of 4 people with average consumption. Given that the cost of installing a tank is estimated to be $2,000 to $3,000, the period it would take to begin to make a saving on the water bill would be up to 20 years. (NSW MEU, 2001)

A final comment...

Rainwater tanks are tried and tested Australian icons for rural households. They are generally more expensive than reticulated water but it makes sense to promote their use in many cities and towns that are growing and approaching the limits to their current capacity.

Build a dam near a river



The climate of Australia is characterised by extremes. As well as significant seasonal variations, floods and droughts colour our climate. Building water storages near a watercourse, called an off-stream dam, has been the traditional strategy to cope with this uncertainty. These dams are filled by pumping water into them from the river at times of high flow and by capturing the surrounding water catchment that would otherwise flow into the river.

An enthusiastic proposal submitted to the Farmhand Foundation by Gordon Jones in NSW, has called for a national program of off-stream dam construction so that we can plan for water shortage instead of relying on our weather patterns. This network of reservoirs and dams would be on all the high points of properties, and, according to Gordon, would provide a consistent ability to rotate crops and allow a much greater potential for crop diversity. Additionally, Gordon recommends large-scale native eucalypt plantings along all fence lines, to help bring rain.

Off-stream dams in Australia are built for the purposes of irrigation, stock, rural and urban supplies and most of them are privately owned. They range from large dams supplying a metropolitan centre such as Grahamstown Dam supplying the Hunter Valley, to the ubiquitous farm dam, which is usually built as ring tanks, sometimes called 'turkey nests'.

Off-stream dams have the advantage of being able to control when water is extracted from the river, taking into account the needs of the river flow. The exception is off-stream dams that capture the sporadic flood flows of a river system.

The greatest concentration of off-stream dams in Australia is in southern Queensland, in the St. George and Dirranbandi region, and in the Balonne-Condamine catchment. There are over 40,000 hectares of dams in the region providing water for mainly cotton farms, which are on average 4 metres deep. One particular dam, Cubbie, Australia's largest private dam, holds one-third of the total storage of the dams in the region (Hodge, 2001) or more water than Sydney Harbour.

A multi-million dollar off-stream dam has been proposed near the NSW town of Boggabilla. The dam plans to build a levee bank of 85kms (the equivalent of Sydney to Wollongong), clear 3500 hectares of native vegetation and use 30 billion litres of water each year to irrigate cotton. Local farmers are worried the dam will rob them of water and destroy the floodplains of the Macintyre River and Whalan Creek. (Woodford, 2002)

Regulation of farm dams varies between states but until recently, off-stream farm dams have not required licensing. The result has been less water for water users located lower down in catchments. In some catchments in Victoria for example, estimates showed that unlicensed off-stream farm dams capture up to 15 times the volume of water extracted from rivers by licensed users (C'wealth SoE, 2001).

Issues

Since European settlement, broad-scale agriculture has created a need for water supplies. After 1945 in Australia, agriculture boomed and a nationwide

figure 47 - Vanishing water and wildlife at Narran Lakes, a Ramsar listed wetland in NSW (Courtesy of NPWS)

program of dam building began to cater for the increased demands for water. These practices have dramatically changed the hydrology of Australia's catchments, altering the natural flow patterns in rivers, streams and wetlands.

Off-stream dams constructed to capture flood flows fundamentally change the natural regime of high flows that many of Australia's unique ecosystems have adapted to. Inland wetland ecosystems rely on minor flooding, the absence of which means many species cannot complete their breeding cycle. For example the Ramsar listed Narran Lakes, which relies on the Balonne-Condamine river system, has lost three-quarters of its water to extractions for off-stream uses (ABC, 2000). NSW National Parks and Wildlife Service river ecologist Dr Richard Kingsford is predicting "a major long term ecological collapse" of the lake system due to the disruption of the water cycle (Dickie, 2000). The flipside of this environmental impact is if floodplains are used for water storage, permanently inundating the area with water and collapsing the floodplain ecosystem.

The nutrient rich, warm still waters of an off-stream dam creates ideal conditions for algal blooms which are a persistent problem in water quality.

The energy requirements of off-stream dams involve pipework and pumps. These are required to extract water from river systems for dam storage and

figure 48 - Port Macquarie off-stream dam, NSW
(Hastings Council)

irrigation systems. Off-stream dams generally should not be located far from the source water in order to reduce pumping costs. They should be built on slightly depressed pieces of land to take full advantage of catchment runoff and rainfall therefore reducing reliance on stream flows.

Dams are large water storages that have the potential to generate a lot of water. Shallow bodies of water such as farm dams can lose much water. Evaporation rates of open water storages are generally 40% to 50%. To reduce the surface area available for evaporation, dams should be deep rather than wide.

In terms of water capacity, off-stream dams can be designed to hold almost any amount. Their construction cost depends on the exact location and site conditions, and how far the water would need to be pumped. A ballpark figure is that it would cost about $2.5 billion to build 15 off-stream dams for a total capacity of 6 million ML (about a dozen Sydney Harbours). Water from the dams would cost about $25 per megalitre. (HWA, 2003) Added to this is likely to be the cost of pumping water into and frequently out of them.

In Port Macquarie

Off-stream dams have the advantage of being able to pump water from the river after the environmental flows have been met and only when good water quality has been confirmed. The recently completed Cowarra off-stream dam in NSW is one such dam. This 10,000 ML water storage dam is required to meet the current and future needs of the Port Macquarie, Wauchope and Camden Haven areas and protect the environment in the Hastings River. Both Cowarra and Port Macquarie Dam will store sufficient water so that:

- During periods of high river flow the dams are filled from the Hastings River.
- In drought conditions when there is low flow in the Hastings River, water will be supplied to consumers from both dams. This is to maintain river flows and protect the river's aquatic environment.
- When the Hastings River water becomes dirty during periods of rainfall and flooding, water need not be pumped. Water supply demands can be supplied from the dams until water quality in the river returns to normal. (Hastings Council, 2003)

In the Yass River catchment, also the water supply for Yass township near the ACT, over 7,000 farm dams occupy a catchment of around 2,000 square kilometres. It is estimated that with so many farm dams intercepting rain water, in 3 years out of 10, the Yass River will not even flow. (Moody, 2003)

A final comment...

Off-streams dams are preferable to on-stream dams in most cases as the water extraction can be controlled and the effects on the riverine environment are far less.

Build a dam on a river

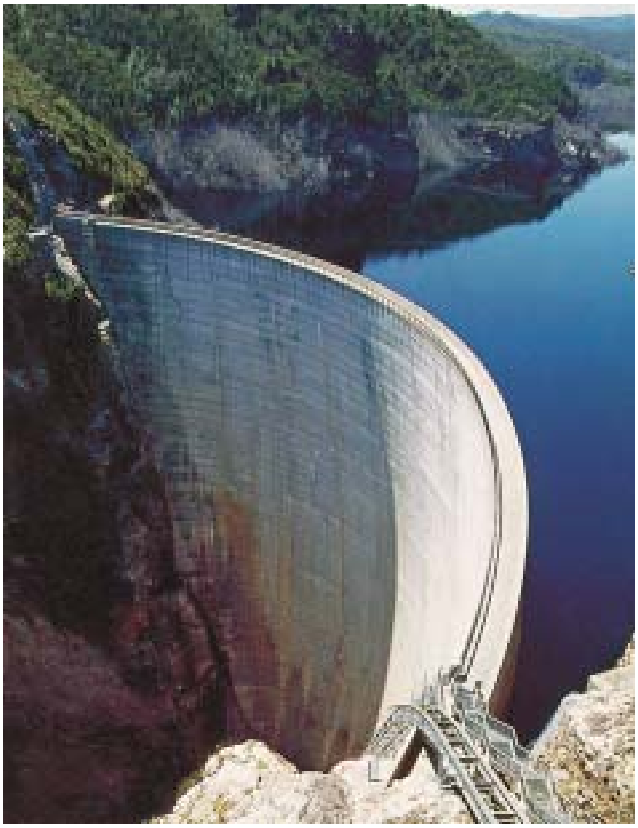


figure 49 - The Gordon Dam, Tasmania
(ANCOLD, 1990)

On-stream dams are exactly that - water storages built on the stream or river to capture the natural flow. They are built for use in agriculture, urban water, electricity and flood mitigation. Some people have suggested that we need to build more large dams on rivers to compensate for our variable rainfall.

On-stream dams are usually large, built across a valley to create an artificial lake that fills the lower part of the valley. The dams have a spillway to release large flood flows so that water does not flow over the dam wall, causing it to breach (AWA, 2002). Weirs are on-stream structures much like small dams that form a barrier across a stream or creek so that water collects behind it.

Australia's storage capacity in major reservoirs totals 94 million ML, which is equivalent to two Olympic-sized swimming pools for every person in Australia (ANCOLD, 2002).

The building of on-stream dams for water storage increased dramatically over the last 70 years, mostly in Western countries. However, as the economic and environmental costs of large dams have become more evident, public opposition has increased, and the construction of more on-stream dams is now more difficult. In Australia, dam construction is becoming more expensive because the most productive sites have already been developed (AWA, 2002).

Issues

Dams are constructed on waterways because it is where water naturally collects, however waterways provide habitat to support fish. Alteration of the natural flow regime of rivers and streams and their floodplains and wetlands is recognised as a major factor contributing to the loss of biological diversity and ecological function in aquatic ecosystems (C'wealth SoE, 2001).

On-stream dams not only change the amount of water that flows downstream, they also change the seasonal patterns of flow, the times of low-flows, high-flows or flood-flows. Low flows are important to maintain summer pools, water quality, watercourse vegetation and macro-invertebrates. High flows are important for riparian vegetation, maintaining channel shape, fish breeding and movement, wetlands and flushing to improve water quality (like getting rid of algal blooms). Flood flows are important to maintain vegetation such as river red gums on the floodplain, and bird breeding.

On-stream dams and to a certain extent weirs essentially isolate different sections of the river system, impeding the natural functioning of their flows and maintenance of river ecosystems. Algal blooms in the dams spread down river and to wetlands, polluting the water. Of the 2000 weirs in NSW, less than a dozen have functioning fishways installed, and many cannot be altered to raise or lower river levels to create a more natural flow regime (Blanch, 1999b).

The Murray-Darling Basin catchment area has 30 large dams and 3,500 weirs, with the dams capable of storing 3 times the annual average flow in the Murray River. Many of the environmental problems associated with dams are illustrated in the Murray-Darling system. Dams often cause changes to downstream riverbeds due to altered sediment loads. In the

> The Gordon dam, or Lake Pedder in Tasmania is Australia's largest dam. It is able to store over 12 million ML (ANCOLD, 2002).

figure 50 - A fish ladder design for an on-stream dam (Sunwater)

Murray, average natural flows to the sea have been reduced by 75%, and dredging is currently required to keep the mouth open. Water temperatures are often altered, creating thermal pollution. Currently cold water released from dams is too cold for fish to spawn and pollutes as much as 3,000km of Australia's water-ways (C'wealth SoE, 2001). Biodiversity is reduced. Ramsar wetlands in the Macquarie Marshes near Dubbo have reduced waterbird breeding opportunities by 100,000 pairs. An estimated 30% of wetlands have been lost in NSW alone through too much or not enough flooding. (Blanch, 1999a)

Seven fish species in inland NSW are classed as 'threatened' by the International Union for the Conservation of Nature. Three of these are classed as in danger of extinction, with flow regulation and cold-water pollution from on-stream dams two of the major factors implicated in their demise (Blanch, 1999a).

Apart from the energy needed in creating the materials for dams (concrete etc), energy may be required to power pumps, valves, aerators and oxygenation facilities.

Dams and rivers have contributed tens of billions of dollars to the Australian economy, however, present and future Australians are faced with the enormous economic and social strain of the repair bill (Blanch, 2002).

One report found that dams deliver less than half the intended amount and, in a tenth of old reservoirs, the build-up of silt has more than halved the storage capacity (ABC, 2000).

On-stream dams do not have the advantage of being able to control the water quality of the incoming flow. In 1998, high levels of the gastrointestinal parasites Cryptosporidium and Giardia were detected in Sydney's drinking water, which was serviced by the on-stream Warragamba dam (McClellan, 1998).

In terms of water capacity, on-stream dams can be designed to hold almost any amount. Their construction cost depends on the exact location and site conditions. A ballpark figure is that it would cost about $2 billion to build 15 on-stream dams for a total capacity of 6 million ML (about a dozen Sydney Harbours). Water from the dams would cost about $20 per megalitre, before environmental costs are taken into account. (HWA, 2003) The location of potential new dam sites are generally remote from users and significant piping, pumping and treatment costs are likely to be involved.

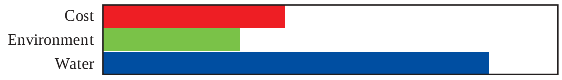
A final comment...

Good locations for on-stream dams are becoming rarer in southern Australia. On-stream dams face increasing environmental hurdles that are raising their costs considerably; added to this are the extra costs of getting the water to users.

Stop Press!

The NSW Carr government has announced that no further on-stream dams will be built in the state. The long-proposed 'Welcome Reef Dam' on the Shoalhaven River north of Braidwood on the NSW south coast was intended as a supplement water supply for Sydney. The 6,000 hectares of bushland planned for flooding will now be placed in a reserve. The government explains that Sydney's per capita use of water has fallen by 16% since 1990-91, and encouraging further water efficiency for Sydney-siders is the way forward. The dam would have cost $1 billion.
(NSW Govt, 2002)

Build a dam in the ocean



It has been suggested that a dam could be built on one of our natural inlets or harbours with the seawater pumped out and allowed to fill by the incoming stream with fresh water. Another suggestion is to build a floating dam to capture the rainfall at sea.

John Dobozy and his son contacted Alan Jones with their idea of an 'Aquadam' - a floating dam to capture the rain which is usually 'lost-at-sea'. Based on the concept that more than 60% of rainfall lands in the ocean, the Gold Coast innovators claim the 'Aquadam' could produce more water than the Hinze Dam, which provides water for their local area. Included in the patent design, stormwater is piped to a wellshaft, connected to the dam. To supplement the supply, up to 100 wind turbines would be built into the dam walls to power a desalination plant that would convert salt water to fresh (see figure 51). The drinking water would then be pumped to a well on the mainland about 5 km away.

The dam would be held in place by about 50 support columns anchored into the ocean floor yet float independently. Mr Dobozy said initial estimates put the cost of the Aquadam around the $150 to $200 million mark. "We believe that building multiple Aquadams around Australia would solve many of the problems relating to drought that we would continually face in the future." The Dobozys are currently trying to gain support for an Aquadam to be built in their hometown, where water restrictions have been in place during the drought. (Unique Planet Pty Ltd, 2003)

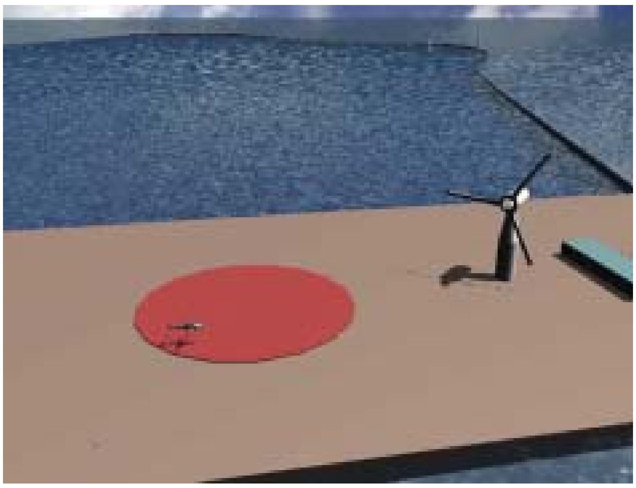


figure 51 - Aquadam
(Unique Planet Pty Ltd) Artwork by Stephen Outram

figure 52 - Plover Dam in Hong Kong
(Courtesy of Hong Kong Government)

The only place where an ocean-based dam exists in the world is Hong Kong. During the 1960s, the Hong Kong Government recognised the growing need for more water as the population continued to increase and the decreasing availability of sites within its borders for dams. On the north shore of Tolo Harbour, a large sea inlet, named Plover Cove, was almost land-locked at its eastern end and engineers conceived the idea of damming this inlet, pumping out the sea and allowing it to fill from its natural catchment with fresh water. The project was completed in 1968, providing the residents with 170,000ML of water. Two years later the dam wall was raised and the reservoir's capacity increased to 230,000ML. The Plover Cove Scheme also has complex pipelines, treatment works and pumping stations connected to distribute and treat water (HKGIC, 1998).

In 1971, the Hong Kong Government saw the need for further reservoir development and implemented the High Island Water Scheme. This scheme involved the construction of two rock dams rising 64 metres above mean sea water level at the eastern and western approaches of the narrow strait running between High Island and the eastern end of the Sai Kung peninsula. This formed a reservoir with a capacity of 281,000ML (HKGIC, 1998).

The necessity and size of the dams, however, has been put into question due to the existence of the Shenzhen Reservoir, just over the Hong Kong border in China. The Shenzhen Reservoir is the single

figure 53 - High Island Water Scheme (Courtesy of Hong Kong Government)

major source of water for Hong Kong supplying over 720 million cubic metres, or 70% of its water (HKGIC, 2002). If the Hong Kong and Chinese governments had developed a joint water plan in the 1960s then it is likely that the ocean-based dams would not have been built.

Issues

Transferability of a concept from one location to another cannot be assumed. While an ocean based dam in Hong Kong may suit the local environment, it may be impractical or uneconomic on Australia's coast.

An ocean-based dam in an estuary would disrupt normal tidal patterns, affecting the hydrology of the coast and the way our beaches are replenished with sand. A dam would affect fish and prawn breeding and migration. This would have adverse impacts for fishing industries, which rely on healthy estuaries. An ocean-based dam would also be a threat to our coastal wildlife, especially birds, which rely on the intertidal areas for food as well as breeding and nesting areas.

A floating dam on the ocean would need to cover many tens of square kilometres in order to collect enough fresh water for a major town. There would be pipelining and pumping costs. Problems with disturbances to fishing and navigation would have to be overcome, and it would have to be stormproof.

The feasibility of ocean-based dams has never been investigated for Australia's coastal areas. However, they are likely to cost far more than either on-stream dams or off-stream dams, perhaps greater than $100 per megalitre (HWA, 2003).

A final comment...

Ocean-based dams are costly and would have to overcome major social and environmental hurdles to be successful.