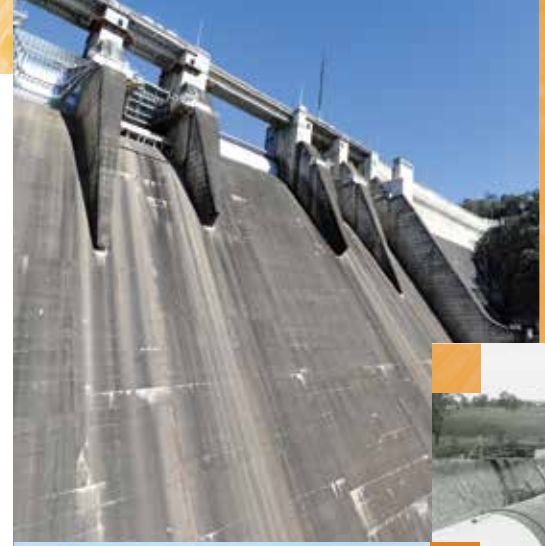


DAMS OF GREATER SYDNEY AND SURROUNDS

Warragamba

WaterNSW

Sydney's drinking water is collected from five catchment areas, occupying 16,000 square kilometres. Water is stored in 21 dams, holding over 2.5 million megalitres of water.

The Warragamba Catchment supplies Warragamba Dam, Sydney's most important source of water. Completed in 1960, Warragamba Dam holds about four times more water than Sydney Harbour and currently accounts for about 80 per cent of the region's available water supply.

< WARRAGAMBA DAM

Introducing WaterNSW

WaterNSW is Australia's largest water supplier. We provide two-thirds of the water used in NSW and develop infrastructure solutions for water supply security and reliability.

We operate and maintain 42 large dams and we deliver water for agriculture and drinking water supply customers. WaterNSW also protects the health of Sydney's drinking water catchment to ensure highest quality drinking water is consistently available.

Sydney's drinking water catchments

The catchments

A catchment is an area where water is collected by the natural landscape. In a catchment, all rain and run–off water eventually flows to a creek, river, lake or ocean, or into the groundwater system.

Natural and human systems, such as rivers, bushland, farms, industry, homes, plants, animals and people can exist alongside one another in a catchment.

WaterNSW helps protect five catchment areas, which provide water to greater Sydney and local communities.

They are:

- Warragamba Catchment
- Upper Nepean Catchment
- Woronora Catchment
- Shoalhaven Catchment
- Blue Mountains Catchment

The catchments occupy about 16,000 square kilometres in total. They extend from north of Lithgow and Blackheath in the upper Blue Mountains, south to the source of the Shoalhaven River near Cooma, and from Woronora in the east to the source of the Wollondilly River near Crookwell.

^ WARRAGAMBA CATCHMENT

Warragamba Catchment

Located about 65 kilometres west of Sydney in a narrow gorge on the Warragamba River, Warragamba Dam is one of the largest domestic water supply dams in the world.

Water is collected from the catchments of the Wollondilly and Coxs River systems, covering an area of 9,050 square kilometres, to form Lake Burragorang behind Warragamba Dam.

Lake Burragorang is the largest urban water supply in Australia, containing about four times the volume of Sydney Harbour. It is the main water supply for more than four million people in the greater Sydney region.

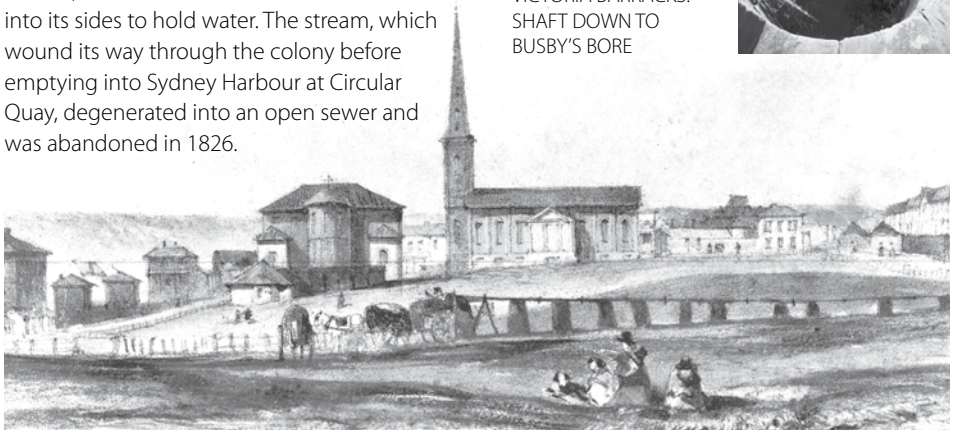
Sydney's evolving water supply system

Australia is one of the driest inhabited continents on earth. Water has been vital to the survival and prosperity of Sydney since the first days of the new colony. The need to ensure a reliable water supply through times of drought and variable seasonal rainfall has driven the development of several complex and innovative water supply schemes.

Sydney's first water supply came from the Tank Stream, named for the 'tanks' or reservoirs cut into its sides to hold water. The stream, which wound its way through the colony before emptying into Sydney Harbour at Circular Quay, degenerated into an open sewer and was abandoned in 1826.

^ TUNNEL INTERIOR UNDER OXFORD STREET

> VICTORIA BARRACKS: SHAFT DOWN TO BUSBY'S BORE



Convict labour then developed Busby's Bore, a four kilometre tunnel leading from the Lachlan Swamps, (now Centennial Park) and ending in the south–east corner of Hyde Park.

By 1852, drought and increasing population led to the call for a more permanent water supply for Sydney. A third water source, the Botany Swamps Scheme, began operations in late 1859 but within 20 years this once copious supply of fresh water was depleted.

The Upper Nepean Scheme was Sydney's fourth source of water supply. Completed in 1888, the Scheme diverted water from a series of weirs on the Cataract, Cordeaux, Avon and Nepean rivers to Prospect Reservoir via 64 kilometres of tunnels, canals and aqueducts, known collectively as the Upper Canal. The building of Cataract, Cordeaux, Avon and Nepean dams between 1907 and 1935 greatly increased the Scheme's capacity.

< BUSBY'S BORE OUTLET, HYDE PARK. PAINTING BY J.SKINNER

Why Warragamba Dam was built

Warragamba River was a short stretch of water, only about 23 kilometres long, that ran from the junction of the Coxs and Wollondilly rivers to its junction with the Nepean River.

The Warragamba River offered two important advantages as a site for a major dam. Firstly it had a large catchment area, and secondly the river flowed through a long narrow gorge. A comparatively tall and narrow dam capable of impounding a vast amount of water could be built.

Its potential was identified as early as 1845. The first sketch plans were drawn up in 1867, but plans were deferred during the construction of the Upper Nepean dams between 1907 and 1935. An increasing demand for water from an expanding population, and a record drought from 1934 to 1942, forced the development of Warragamba Dam to ensure a reliable water supply.

^ WOLLONDILLY RIVER IN BURRAGORANG VALLEY BEFORE FLOODING

In the interim, the Warragamba Emergency Scheme was built to urgently address Sydney's critical water shortage. This scheme consisted of a weir and pumping station on the Warragamba River and a pipeline to Prospect Reservoir. It began operating in 1940 and was in use for almost 19 years until the dam was completed.

How Warragamba Dam was built

Warragamba Dam was a major engineering feat of the mid 20th Century.

Following extensive geological examination, two temporary dams and a tunnel to divert the river were built first. More than 2,300,000 tonnes of sandstone were removed from the site.

Concrete was mixed on site using 305,000 tonnes of cement and 2,500,000 tonnes of sand and gravel. The sand and gravel were transported from McCann's Island in the Nepean River via a unique aerial ropeway.

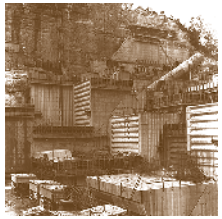
The dam was built in a series of large interlocking concrete blocks. A system of overhead cableways lifting 18 tonne buckets was used to place the concrete.

> LEFT TO RIGHT

CELEBRATING THE TWO MILLIONTH TON OF CONCRETE POURED

WARRAGAMBA WALL UNDER CONSTRUCTION

INTERLOCKING CONCRETE BLOCKS



Ice was mixed with the concrete to control heat generation and to prevent cracks from forming. One of the first pre–stressed concrete towers in Australia was built to house the ice–making plant.

Residents living in the Burragorang Valley, which was to be covered by rising waters, were relocated. More than 64 square kilometres of trees were cleared so they would not rot and float downstream, to block the dam's outlets and crest gates.

Pedestrian access between the Warragamba township and the work area was provided by two suspension bridges, one across Folly Creek and the other across the Warragamba Gorge just downstream of the dam.

When the then Premier of NSW, the Hon. Robert J. Heffron MP, officially opened Warragamba Dam on 14 October 1960, thousands of guests, workers and their families gathered for a day of celebration.

Life in the Warragamba township

Warragamba was established specifically as a construction town. At its peak the town housed about 3,500 people, in mostly prefabricated cottages, as well as barracks for single men and women. Some 1800 men from at least 25 nationalities, many of whom were post WWII immigrants, worked alongside each other with little friction.

Work, family and social activities all centered around building the dam. The Water Board provided roads, utilities and other services but many of the town amenities could not have existed without the voluntary labour and fundraising activities of the residents.

Unlike other communities that disappeared almost overnight once dam construction ended, Warragamba has remained a close–knit township which even today proudly highlights its relationship with its awe–inspiring neighbour.

^ TOP TO BOTTOM

WARRAGAMBA PRESCHOOL, 1955

FESTIVAL OF CAROLS, 1964

Construction History

Geological investigations	1942
River diversion works	1946
Site works	1948
Excavation	1950
Concrete pour	1953
Completed and opened	1960
Wall raised five metres	1989
Auxiliary spillway completed	2002
Deep water pumping station refurbished	2006
Electrical upgrade completed	2009
Crest gate upgrade completed	2012

How the dam works

^ THE VALVE HOUSE, WARRAGAMBA

^ AN INSPECTION GALLERY INSIDE WARRAGAMBA DAM

Warragamba Dam supplies bulk water to three water filtration plants where it is filtered and distributed to people living in Sydney and the lower Blue Mountains.

The best quality water is selected and drawn through screens at three outlets in the upstream face of the dam. After flowing by gravity to the valve house, two pipelines feed the raw water to Prospect water filtration plant and via off–takes to smaller filtration plants at Warragamba and Orchard Hills. The filtered water is then distributed to households, businesses and other users.

The five crest gates, central spillway, dissipater training walls and apron (stilling pond) all manage the discharge of normal floodwaters and are critical to dam safety. The auxiliary side spillway will operate only in rare and extreme floods, and will divert excess floodwaters around the dam. Eraring Energy owns and operates the 50–megawatt hydro–electric power station at Warragamba which generates green power only when there is a high level of water in the lake.

How the dam is monitored

WaterNSW officers inspect and monitor Warragamba Dam through a network of more than five kilometres of galleries. They monitor water pressure, seepage, and any physical changes in the dam structure and its foundations to ensure these are within acceptable limits.

Warragamba Dam was designed to deflect slightly as the lake level rises and falls. These deflections are measured regularly using precise surveying techniques. Sensitive seismic equipment located in the dam and surrounding catchment monitors earth movements. Crest gates, valves, pipelines and associated equipment are regularly inspected and maintained.

Safeguarding the dam

Rainfall and flood event studies showed that the dam could experience floods much larger than originally estimated. As the first step in a two–stage solution, the height of the dam wall was increased by five metres. Work took place between 1987 and 1989 as the dam wall was raised and strengthened using post–tensioned steel cables, tying the upper portion of the wall to its base.

In early 1999 work began on stage two of the dam safety program, involving the construction of an auxiliary spillway located on the east bank of the dam. During rare and extreme floods, the auxiliary spillway will allow floodwaters to pass safely around the dam, reducing the pressure on the dam wall and ensuring its safety.

In 2008 work began to upgrade the drum and radial gates located on the top of the dam to enable them to withstand extreme floods. These gates are a dam safety mechanism used to control the release of flood water from the dam. The upgrade to the gates involves installing locking systems to secure the gates in a fully open position. This mechanism will mean the radial gates can be moved out of the way in very extreme floods, protecting the gates should one of these floods occur. The gates were also strengthened and refurbished.

Prospect Reservoir

Prospect Reservoir is located on Prospect Creek, approximately 35 kilometres west of Sydney. The dam was completed in 1888 and was the first earthfill embankment dam in Australia. Its original purpose was to store water fed by gravity from the dams of the Upper Nepean system, via the Upper Canal.

From there the Lower Canal led to a basin at Guildford, from where water was piped to several reservoirs around the city.

Water from the Warragamba Emergency Scheme reached Prospect Reservoir in May 1940. The water was piped across Megarrity's Creek Bridge at Warragamba, and another 26 kilometres to Prospect Reservoir. With the completion of Warragamba Dam in 1960, Prospect Reservoir continued to play an important role in storing Sydney's water supply. A second pipeline linking Warragamba and Prospect Reservoir was completed in 1966, significantly increasing the volume of water that could be transferred during peak demand periods.

> AERIAL VIEW OF PROSPECT RESERVOIR

Prospect Reservoir was strengthened by the placement of stabilising beams on the downstream face in 1979, and the upstream face in 1997. Additional dam upgrades were completed in 2014.

Ensuring dam safety

It is essential that all WaterNSW dams meet the requirements of the NSW Dams Safety Committee (DSC) under the *NSW Dams Safety Act 1978*. The DSC, the State's regulator for dam safety, develops and implements policies and procedures for effective dam safety management in order to protect life, property and the environment from dam failures.

To ensure compliance with its operating licence, WaterNSW has adopted a structured program of surveillance and monitoring that complies with the requirements of the DSC and national and international best practice.

^ CLOCKWISE FROM ABOVE

WATERNSW OFFICERS ROUTINELY MONITOR THE DAM WALL FOR SAFETY REQUIREMENTS

PROSPECT RESERVOIR AND VALVE HOUSE

A SURVEYOR USES A THEODOLITE TO MEASURE KEY POINTS ON THE DAM WALL

Did you know?

Warragamba Emergency Scheme, Megarrity's Bridge, and Prospect Reservoir and Valve House are listed on the State Heritage Register.

Monitoring water quality

In Greater Sydney's drinking water catchment, WaterNSW conducts extensive routine water quality and quantity monitoring in the catchments, storages and in–flows to water filtration plants. Monitoring provides information to enable the best quality water to be drawn–off into the supply system, and to identify areas requiring special catchment management attention. WaterNSW also conducts regular testing at several locations for the presence of the protozoan parasites *Giardia* and *Cryptosporidium* in the water. Information collected from WaterNSW's monitoring programs is used for public health reporting and assessment.

Maintaining good water quality in the catchment

WaterNSW works with government, industry and the community to promote good water quality and healthy, sustainable catchments.

Extensive research is carried out by WaterNSW to help understand the catchment environment. WaterNSW also plays an important role in working with councils to ensure that proposed land use and development is compatible with preserving water quality.

Field staff undertake a range of on–ground activities in the catchments, such as pest control, fire control, erosion control and repair, regulating access, containing spills, chemical collections and weed control. In the Special Areas (land closest to the storages) the National Parks and Wildlife Service (Office of Environment and Heritage) and WaterNSW.

Many successful projects are also undertaken jointly with landholders, other agencies and community groups including riverbank stabilisation, willow removal, revegetation and riverbank fencing.

Environmental flows

WaterNSW recognises that dams can affect the natural flow of water downstream. Providing water to the river through environmental flows is one way to help restore ecological processes and biodiversity of water dependent ecosystems. Currently, WaterNSW releases five million litres of water per day from Warragamba Dam into the Nepean River for environmental and riparian purposes.

WATERNSW UNDERTAKES WATER QUALITY MONITORING IN THE CATCHMENTS AND STORAGES

Fact file

Warragamba Dam

Height	142 m
Length	351 m
Thickness at base	104 m
Width of central spillway	94.5 m
Concrete mass	3,000,000 t
Width of auxiliary spillway (at mouth)	190 m
Length of auxiliary spillway	700 m

^ WARRAGAMBA DAM WALL

Lake Burragorang

Total Capacity	2,031,000 ML
Area	75 km^2
Length of lake	52 km
Length of foreshores	354 km
Maximum depth of reservoir	105 m
Catchment area	9,051 km^2
Average annual rainfall	917 mm

^ LAKE BURRAGORANG, WHICH IS FORMED BY WARRAGAMBA DAM

Pipelines

Diameter	2,100/3,000 mm
Length	27 km each
Capacity	2,600 ML per day

^ CONSTRUCTION OF WARRAGAMBA-PROSPECT PIPELINE, FEB 1966

Prospect Dam

Height	26 m
Length	2,225 m
Total capacity	50,000 ML
Catchment	9.7 km^2

^ PROSPECT RESERVOIR

Recreation at Warragamba Dam

Warragamba Dam Grounds

Warragamba Dam is located about 65 kilometres west of Sydney and is an ideal spot for picnicking. Facilities are set in natural bushland surroundings and include picnic shelters, shade trees, viewing areas and drinking water. Barbecue facilities and a children's playground are also available in the nearby Warragamba Recreation Reserve. There are no entry fees to any of our dams. Picnic areas cannot be reserved.

There is public access to the Warragamba Dam wall only on weekends and public holidays. There are no guided tours of the dam available. The precinct includes three viewing areas that provide good views of the dam wall and Lake Burragorang. A viewing platform located at the end of Eighteenth Street, Warragamba also provides views of the dam and auxiliary spillway.

Visiting hours are 8am to 5pm daily (6pm on weekends and public holidays during daylight saving time).

Warragamba Dam Visitor Centre

The Warragamba Dam Visitor Centre includes educational facilities, an exhibition area featuring audio-visual material and interactive displays about Sydney's drinking water dams and catchments, and the history and future of Sydney's water supply.

The Visitor Centre is closed on Christmas Day and Good Friday. For more information on the Warragamba Dam Visitor Centre visit www.waternsw.com.au.

Education at Warragamba

WaterNSW offers a range of syllabus linked programs suitable for educational groups. For educational excursions and project material, please contact our Education Office on (02) 4774 4435.

^ PUBLIC ACCESS TO THE DAM WALL IS AVAILABLE ON WEEKENDS AND PUBLIC HOLIDAYS

Warragamba Dam facilities

Drinking water

Viewing area

Picnic Shelters

Toilets

Burragorang Lookout and Prospect Reservoir

Burragorang Lookout

Spectacular, panoramic views of Lake Burragorang can also be seen from Burragorang Lookout, which is located near Nattai in Sydney's south–west. Burragorang Lookout is part of the National Parks and Wildlife Service's (NPWS) Nattai Reserves System.

< A VIEW OF THE LAKE FROM BURRAGORANG LOOKOUT

Prospect Reservoir Picnic Area

Prospect Reservoir Picnic Area, which is owned and managed by Sydney Water, is open to the public every day of the year between 10.00am and 4.45pm.

For weekends and public holidays during daylight saving time only, the picnic area remains open until 6.45pm. Facilities include barbeques, toilets, and children's playgrounds.

Burragorang Lookout facilities

- BBQs
- Toilets
- Viewing Area

Prospect Reservoir Picnic Area facilities

- BBQS
- Playground
- Toilets
- Viewing Area

How to get there

Warragamba Dam is located on the Warragamba River about 65km west from Sydney.

Take Mulgoa Road from Penrith (or Northern and Park Roads from the south) to Wallacia, then Silverdale Road and Production Avenue to Warragamba Dam.

Burragorang Lookout is located near Nattai in Sydney's south–west.

From Camden, take Druitt Lane, (which turns into Burragorang Road), to Nattai and continue to the lookout. From Picton, take Barkers Lodge Road to Oakdale, then west to Nattai.

Prospect Reservoir - Travelling west on the M4, take the Prospect Highway exit. Turn left at the roundabout, and right at the T–intersection. The entrance to Prospect Reservoir is the second turn on the left.

If travelling east on the M4, take the Reservoir Road exit. Turn right onto Reservoir Road. The entrance is approximately two kilometres on the right.

Why Special Areas are protected

About 28 per cent of the Warragamba Catchment is classified as Special Area. In total, Special Areas cover about 3,700 square kilometres of land surrounding WaterNSW's water storages.

< SPECIAL AREAS ACT AS BUFFER ZONES TO PROTECT WATER QUALITY

The Special Areas protect our water supply because they act as a buffer zone, helping to stop nutrients and other substances that could affect the quality of water entering the storages.

WaterNSW and the National Parks and Wildlife Service (Office of Environment and Heritage) jointly manage the Special Areas, in accordance with the Special Areas Strategic Plan of Management.

This long–term plan aims to provide high quality water in the storages, ensure ecosystem integrity, and improve the environmental quality of the catchment areas.

Public access to parts of the Special Areas is restricted to protect water quality. This benefits the community by:

- ensuring we have safe, clean water
- protecting large areas of bushland and plant and animal habitats
- protecting threatened plants and animal species
- preserving evidence of Aboriginal heritage dating back many thousands of years
- preserving evidence of European exploration, early settlement, and phases of development such as forestry, mining and dam building.

Restrictions and controls are placed on land use, development, and access within Special Areas. Activities such as swimming, fishing, boating and camping are prohibited, unless otherwise specified.

Access and the Special Areas

Under the *Water NSW Act 2014*, there are two water quality protection zones – Schedule One and Schedule Two. These zones are collectively called the Special Areas.

Schedule One:

In Warragamba Catchment, Schedule One land extends in a radius of three kilometres from the top of the stored water level in Lake Burragorang. All access, either on foot or by vehicle, and including motorcycles, bicycles and horses, is prohibited. The only exception is an access corridor for walkers from Katoomba to Yerranderie or Mittagong via Beloon Pass.

Schedule Two:

Schedule Two is the second–tier water quality protection zone, and adjoins Schedule One. Vehicular access is restricted (as are motorcyclists, bicyclists and horse riders), but walkers are generally permitted. Fines of up to $22,000 for individuals and $44,000 for corporations apply for unauthorised or illegal activity in Special Areas.

How you can help keep our catchments healthy

In the catchments

People living and working in the catchments areas play a special role in keeping our catchments healthy. Some of the ways people in the catchments help include:

- using chemicals efficiently and carefully
- controlling weeds and pests
- retaining and planting vegetation to prevent soil loss
- protecting stream bank vegetation to provide a buffer against pollution
- managing on–site sewage systems effectively
- encouraging and developing improved sewage and stormwater management systems
- preventing bushfires
- reporting spills
- getting involved in a Landcare, Streamwatch or other local community group.

Saving water

Water is a precious resource. Each of us has a responsibility to reduce the amount of water we use – no matter where we live.

By reducing the amount of water we all use, we reduce the need to build expensive new water supply infrastructure such as dams, reservoirs and pipelines.

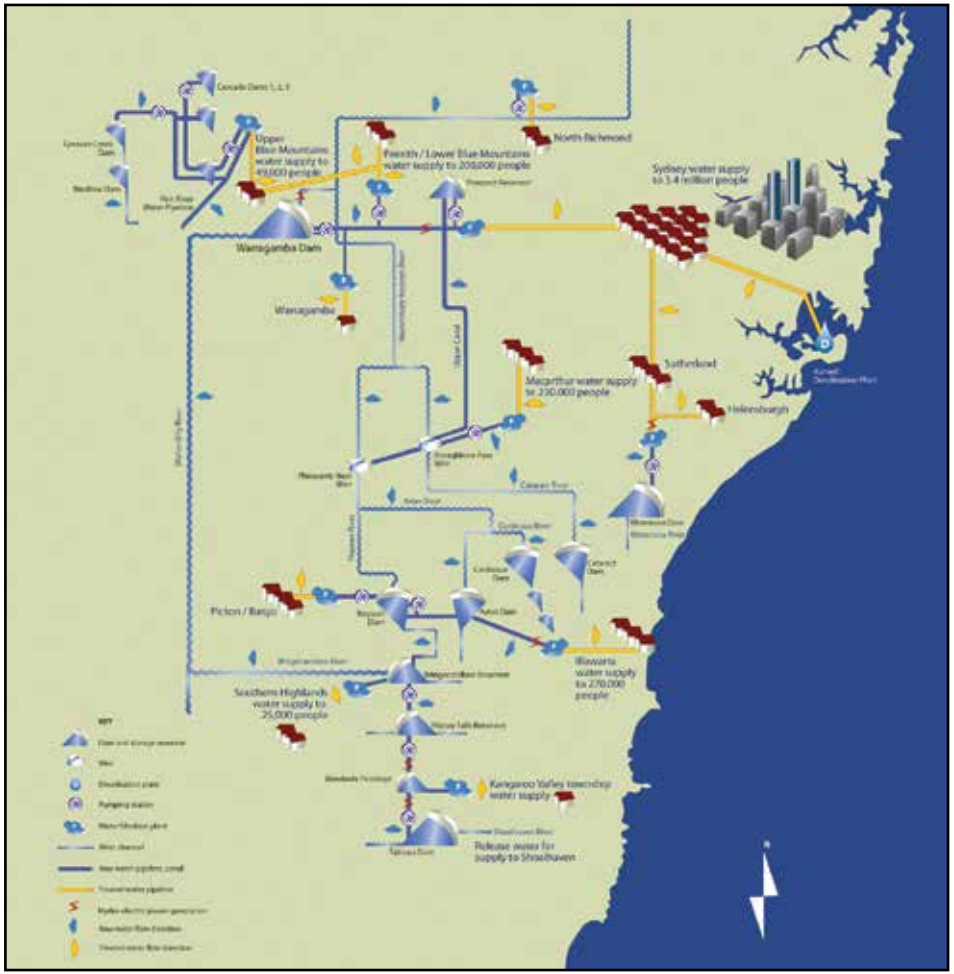
Reducing the amount of water we all use can also help make more water available for environmental flows, which protect the health of the rivers downstream of the dams.

WaterNSW also recognises the need to adopt exemplary practices in managing our own business. Minimising leaks in pipelines and fitting water saving appliances and devices are just some of the ways WaterNSW is reducing the amount of water we use.

Water saving tips

For great water savings ideas visit www.waternsw.com.au/water-quality/education/learn/using-less-water.

Sydney's water supply system



Contacting WaterNSW

169 Macquarie Street, Parramatta 2150
PO Box 398, Parramatta NSW 2124

Phone 1300 662 077
Office hours 8.30am to 5pm Monday to Friday
Website www.waternsw.com.au
Email customer.helpdesk@waternsw.com.au

Visitor information

Warragamba Dam Visitor Centre
Phone + 61 2 4774 4433
Hours 10am to 4pm daily
except Christmas Day and Good Friday

Other dams, reservoirs and camping grounds
Phone 1300 662 077
Hours 8.30am to 5pm Monday to Friday

Emergency reporting (24 hours)

Fires, chemical spills
Phone: 1800 061 069

Important

Information contained in this brochure may change after the date of printing. WaterNSW accepts no responsibility or liability for any loss or inconvenience incurred as a result of reliance upon information printed in this brochure. For the most up–to–date information on WaterNSW dams and recreational facilities, call 1300 662 077 or visit our website at www.waternsw.com.au

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