Sydney WATER

Best practice guidelines

for water conservation in commercial office buildings and shopping centres

Contact us

www.sydneywater.com.au

Enquiries
Call 13 20 92

Service difficulties and emergencies
Call 13 20 90

Postal address
Sydney Water
PO Box 53
SYDNEY SOUTH NSW 1232

every drop counts

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NSW GOVERNMENT

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PO Box 53
Sydney South
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www.sydneywater.com.au

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Best practice guidelines

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Sydney Water's Every drop counts business program works closely with businesses to achieve sustainable water savings.

The **Best practice guidelines for water use in commercial buildings and shopping centres** bring together the vast water conservation experience of the Every Drop Counts Business Program. They are a practical resource to help building managers improve water efficiency.

Since the program started in 2001, we have teamed with 375 business partners, representing over 1,900 sites. Together, we have implemented projects that save 34 megalitres of water a day. The successes of the program and significant work of our business partners was recognised with the prestigious 2006 Stockholm Industry Water Award. This was the first time an Australian organisation has received the award.

We work with the owners and managers of over 450 Sydney-based commercial properties. Practical ways to save water are identified through management diagnostic sessions, detailed water efficiency audits and real-time water monitoring. Feasibility studies to assess specific water conservation measures are another feature of the program. The areas covered include harvesting condensate from cooling systems, reducing water use to test fire suppression systems and assessing cooling tower performance.

We will continue to help our partners improve their business water use efficiency and make a significant contribution to the NSW Government's Metropolitan Water Plan to secure Sydney's water supply.

Kerry Schott
Managing Director
Sydney Water

Acknowledgements

Sydney Water thanks the following people and organisations for help in the development of the **Best practice guidelines for water conservation in commercial buildings and shopping centres** and for their critical and constructive reviews of the document:

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Contents

Part 1

Understanding your water use

Part 1 of **Best practice guidelines for water conservation in commercial office buildings and shopping centres** presents benchmarks for water use in commercial buildings and information to help you manage your water better.

Chapter 1

Why save water in your commercial building?

These guidelines provide information that will help you save water in your commercial building. But why should you be interested in saving water?

It saves you money

If you use less water you pay less in water, sewage and trade waste charges. Using less water means you are heating, pumping and treating less water. By buying smaller pumps and hot water heaters you will reduce energy, chemicals and capital costs.

It gives you a competitive advantage

Benchmarking studies by Sydney Water show that many buildings have not implemented water saving projects that have a return on investment of less than two years. If you put simple water conservation measures in place you will be ahead of the competition and make easy cost savings. As the cost of water and energy increases, water conservation becomes more and more cost effective.

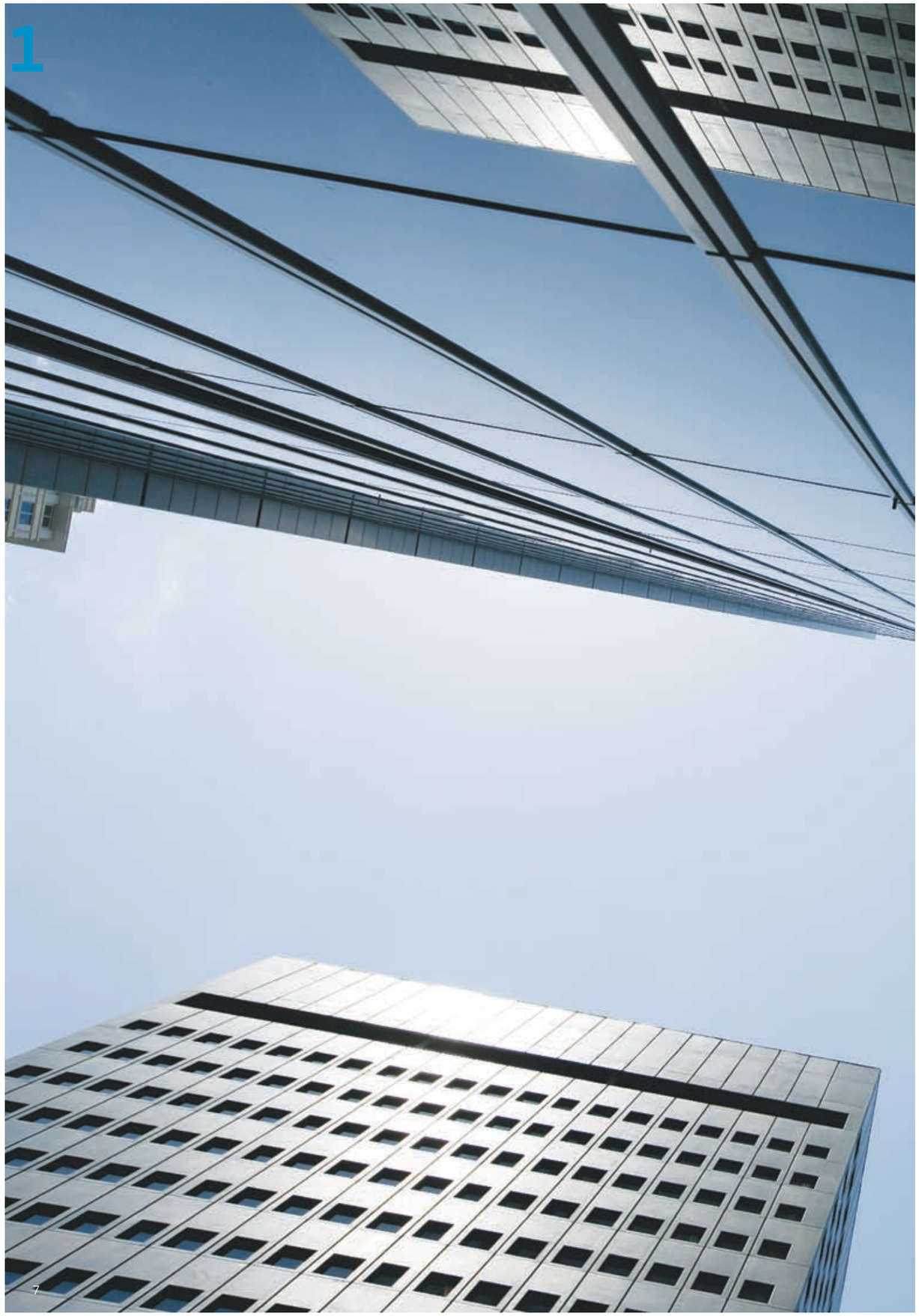
Saving water today means water is available tomorrow

Long term changes to rainfall, population growth and climate change will reduce the volume of water available from our catchments. Being more water efficient means you can run your businesses and still have water available tomorrow.

Businesses that manage water well are better businesses

Managing water means improving the communication, record keeping, adaptive management and decision making abilities of your business. These improvements flow on to other aspects of your business to make it more efficient and adaptable.

Read on to find out how to save water in your commercial building.



Chapter 2

A snapshot of commercial buildings in Sydney

How much water do Sydney's commercial buildings use?

Sydney Water data shows that commercial buildings account for almost 20 per cent of business water use in Sydney – or nearly 75 million litres of water every day. This figure includes water used by the many cafes and restaurants that are located in commercial office buildings and shopping centres.

Commercial office buildings

The amount of lettable office space in Sydney, the Blue Mountains and the Illawarra is increasing. Data compiled by the Property Council of Australia shows that at the beginning of 2007 nearly 7.4 million square metres of lettable office space was located in the region.

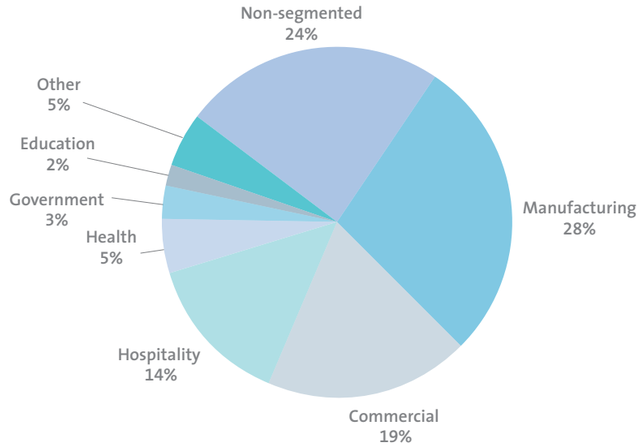


Figure 1 – Water used by commercial buildings in Sydney in 2006 as a proportion of total business water use.

Figure 2 shows that office space in Sydney Water's area of operations increased by 30 per cent from January 1997 to January 2007. Office space vacancies have fluctuated, as illustrated in Figure 3, but increased overall by 1.1 per cent during the same period. The overall increase in occupied office space emphasises the importance of improving water efficiency in commercial office buildings and indicates that building owners and managers are in an increasingly strong position to influence water efficiencies in commercial buildings.

Shopping centres

According to the Property Council of Australia, 278 shopping centres in Sydney, the Illawarra and the Blue Mountains contain supermarkets and specialty stores. This represents more than half the 408 centres in New South Wales and the ACT.

A breakdown of the number of shopping centres by centre type is provided in Figure 4. The total lettable area of shopping centres located in Sydney Water's area of operation stands at more than 4 million square metres.

Major regional centres account for the largest proportion of available gross lettable area (GLA) in Sydney Water's area of operation. This is in contrast to all of New South Wales where sub regional shopping centres are the largest contributor to GLA.

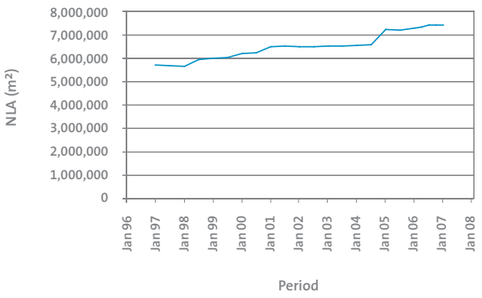


Figure 2 – Trends in the area of lettable office space in Sydney, Blue Mountains and Illawarra from January 1997 to January 2007.

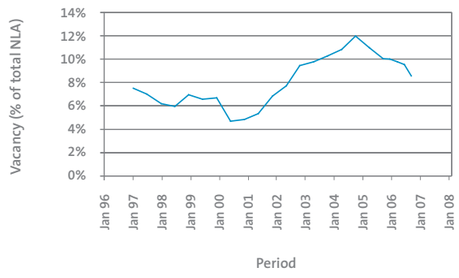


Figure 3 – Trends in office space vacancies in the Sydney, Blue Mountains and Illawarra regions from January 1997 to January 2007.

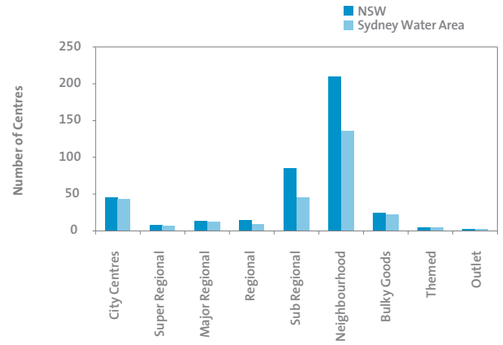


Figure 4 – The total number of shopping centres (by type) in the Sydney, Blue Mountains and Illawarra regions.

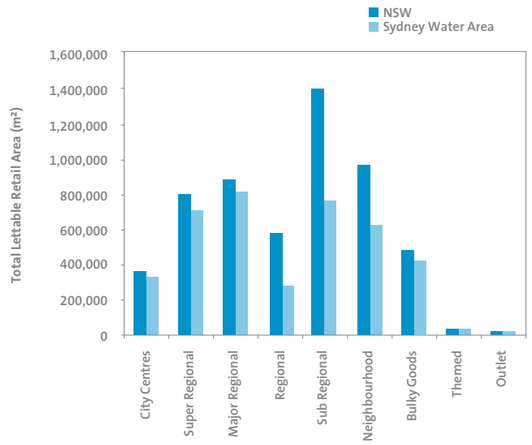


Figure 5 – Breakdown of total gross lettable area by shopping centre type in the Sydney, Blue Mountains and Illawarra regions.

Table 1 – Classification of shopping centres as defined by the Property Council of Australia (2006).

Classification	Definition
City centre	Retail premises within a CBD arcade or mall with a gross lettable area (GLA) greater than 1,000m²
Super regional centre	GLA greater than 85,000m²
Major regional centre	GLA 50,000–85,000m²
Regional centre	GLA 30,000–50,000 m²
Sub-regional centre	GLA 10,000-30,000m²
Neighbour-hood centre	GLA less than 10,000m²
Bulky Good centre	Dominated by bulky goods retailers, GLA generally more than 5,000m²
Themed centre	A specialty centre typically located in resort areas to cater for specialist tourist needs

Chapter 3

Water use benchmarks for commercial office buildings

Sydney Water has developed water consumption benchmarks for commercial office buildings in Sydney. These benchmarks allow you to assess opportunities for cost effective water savings in your commercial building.

Sydney Water benchmarks use information gathered in 31 water efficiency audits conducted by the Every Drop Counts (EDC) Business Program. They are for Sydney office buildings only. They should not be used for buildings in other climate zones.

An explanation of the Sydney Water benchmarks is provided below.

Median market practice with no leaks

Table 2 shows how much water an average office site in Sydney will consume if it is leak free. If the water consumption of your office building is higher than these benchmarks, there is a good chance the building's water system has substantial leaks. You should investigate this immediately.

Economic best practice

Economic best practice in water efficiency projects is the level of performance that you should be able to achieve to attain a two year return on investment. This benchmark should be your performance target for good business practice. Fixing leaks and improving the efficiency of amenities are some of the most cost effective ways of reducing water consumption in your building.

Very well managed building

A very well managed building demonstrates an exceptionally low level of water consumption. To achieve this you will probably need a building with good design, strong management attention to water and the use of long term technical measures, some of which may not be financially viable on water savings alone.

Table 2 – Benchmarks for water efficiency in Sydney office buildings.

Benchmark	Offices with cooling towers	Offices without cooling towers (extrapolated figures)
Median market practice with no leaks	1.01 kL/m²/year	0.64 kL/m²/year
Economic best practice (median of implementing water saving projects with two year paybacks)	0.84 kL/m²/year	0.47 kL/m²/year
Very well managed building	0.77 kL/m²/year	0.40 kL/m²/year

How to calculate your water consumption benchmark

To assess your water consumption against these benchmarks, you need to know the net lettable area of your building in square metres and its annual water consumption, as follows:

The net lettable area of your building in square metres

The net lettable area of your building is usually the area that determines the rental rates for your tenants, as assessed under the Property Council 1997 Method of Measurement.

Your building's annual water consumption

The annual water consumption of your building is all water consumed for the office building. If you have other facilities attached to your building such as retail, gyms or hotels, you may exclude the water consumption of these spaces. You should be able to find the total water consumption in kilolitres for a full year from your water bills. If you are not billed in kilolitres you may need to convert the units of your water bill.

Once you have accessed this data, divide your total water consumption by your total net lettable area. This will provide your benchmark water consumption in kilolitres per square metre per year (kL/m²/year).

These benchmarks give you a guide to your building's current performance and indicate the savings you will be able to make. If your building fails to meet the benchmark for eliminating leaks or for economic best practice, you are most likely to have substantial water saving opportunities in your building and should act to improve your water consumption.

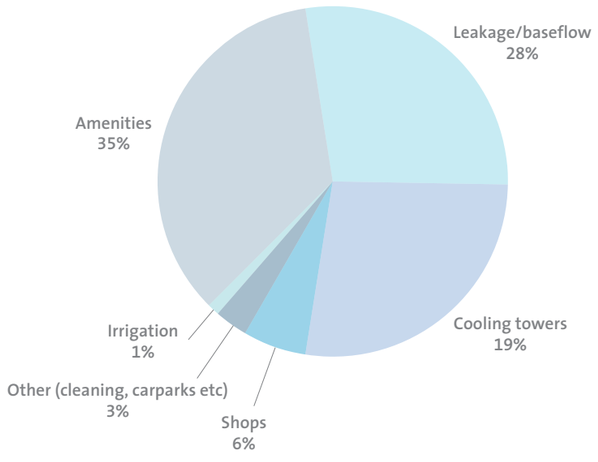


Figure 6 – Typical water distribution in a commercial office building, including leaks.

If you have a very large shopping centre linked to your office building you should sub meter the water consumption of the shopping centre. You can then benchmark water use in the shopping centre against the benchmarks provided in Chapter 4 of these guidelines.

If you have only a few retail leases in your building and cannot effectively sub meter them, your office water consumption is likely to be affected. To compensate for this you can refer to the adjusted benchmarks in the Appendix of these guidelines.

How these benchmarks relate to NABERS

The Sydney Water benchmarks provided in these guidelines are designed to give you more information about the performance of your building and your likely opportunities for saving water.

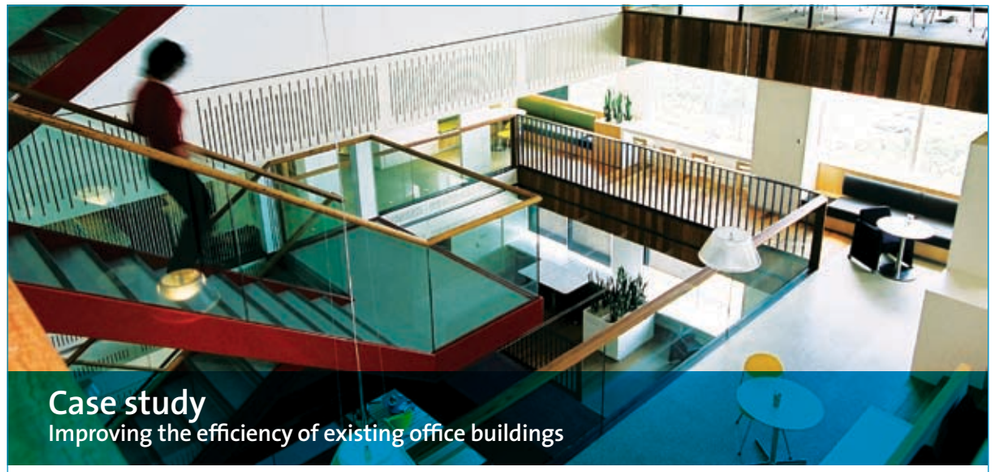
Sydney Water benchmarks do not replace star ratings provided by the National Built Environmental Rating Scheme (NABERS). The NABERS assessment process provides a more formal, quality controlled rating for your building and will make sure that water consumption is adjusted for hours of occupancy.

At September 2007, more than 80 commercial buildings in Sydney had been assessed for efficiency by the NABERS rating process.

Table 3 shows how your water consumption relates to the Sydney Water benchmarks and NABERS Water star ratings. It shows if you are within the target water consumption zone for a building of your type and if you have opportunities to reduce water consumption.

Table 3 – Comparison of Sydney Water performance benchmarks and NABERS water star ratings for a commercial office building in Sydney

Water consumption (kL/m²/year)	Sydney Water performance benchmarks	NABERS water star rating	
1.80 1.75 1.70 1.65 1.60 1.55 1.50 1.45 1.40 1.35 1.30 1.25 1.20 1.15 1.10 1.05		1 star (1.73) 2 star (1.39) 2.5 star (1.21) 3 star (1.04)	Leak Zone
1.00 0.95 0.90 0.85	Average practice for buildings with cooling towers and no leaks (1.01) Economic best practice for buildings with cooling towers (0.84)	3.5 star (0.87)	Cost effective improvement zone for water cooled buildings
0.80 0.75 0.70	Well managed building with cooling towers (0.77)	4 star (0.70)	Target zone for water cooled buildings
0.65 0.60 0.55 0.50 0.45	Average practice for buildings without cooling towers and no leaks (0.64) Economic best practice for buildings without cooling towers (0.47)	4.5 star (0.52)	Cost effective improvement zone for buildings without cooling towers
0.40 0.35	Best practice for buildings without cooling towers (0.40)	5 star (0.35)	Target zone for buildings without cooling towers



Case study
Improving the efficiency of existing office buildings

In the refurbishment of its Sydney headquarters in Castlereagh Street, the Stockland Property Group demonstrated how much water can be saved in existing office buildings.

Before refurbishment began in 2005, the Stockland building used 1.91 kilolitres per square metre of water a year. This figure included water used by shops and food outlets in the building's retail areas.

During refurbishment, Stockland installed waterless urinals and WELS rated efficient taps. Cooling towers were replaced with more efficient models and more sub meters were installed to help building managers keep track of water use. A water management plan was implemented and the new fire service test standard was introduced. Rigorous controls on equipment were documented. This enables building managers to cut the frequency of tests.

After refurbishment the Stockland building housed 650 staff on eight floors of office space. The benchmark for water use fell by more than 22 per cent, saving 18,240 kilolitres of water a year (excluding the building's retail tenancies).

Stockland was one of the first large scale commercial property owners to get a NABERS rating for its entire portfolio.

Photograph 1 – Stocklands House at 175–183 Castlereagh Street Sydney is a good example of an existing office building that has significantly reduced its water consumption as a result of refurbishment.

References

Property Council of Australia (2006), Directory of Shopping Centres – New South Wales and Australian Capital Territory 2006.

Chapter 4

Water use benchmarks for shopping centres

Sydney Water has developed best practice water consumption benchmarks for shopping centres. These benchmarks were developed using information from 12 water efficiency audits conducted by the EDC Business Program.

An explanation of these three benchmarks is provided below.

Median market practice with no leaks

Median market practice is the volume of water consumed by an average shopping centre with no leaks. If your water consumption is higher than this there is a good chance you have substantial leaks in your shopping centre. You should investigate this immediately.

Economic best practice

Economic best practice is the performance you should be able to achieve using the criteria of a two year return on water efficiency investment. This benchmark should be your performance target for good business practice. Fixing leaks and improving the efficiency of amenities are some of the most cost effective ways of reducing water consumption in your building.

Very well managed shopping centre

A very well managed shopping centre has good design, strong management attention to water and use of longer term technical measures – some of which may not be financially viable on water savings alone.

How to calculate your water consumption benchmark

To assess your water consumption against these benchmarks you need to know the gross lettable area of your shopping centre and its water consumption over 12 months.

The gross lettable area of your shopping centre in square metres

This is the area used to determine the rental rates for your tenants. It should be assessed under the Property Council of Australia 997 Method of Measurement.

The water consumption of your shopping centre over 12 months

This figure should include all water consumed for the shopping centre.

Table 4 – Benchmarks for water efficiency in Sydney shopping centres

Benchmark	Value
Median market practice with no leaks	1.70 kL/m²/year
Economic best practice (median of implementing 2 year paybacks)	1.68 kL/m²/year
Very well managed shopping centre	1.35 kL/m²/year

About Sydney Water benchmarks for shopping centres

It is important to note that Sydney Water benchmarks are based on a very small sample of data from shopping centres. The benchmarks may not be truly representative of all shopping centres because shopping centres vary widely in design, size, pedestrian volume and the type of businesses they house.

It is also possible that some existing shopping centres are performing better than the benchmarks indicate.

The Sydney Water benchmarks provide a basic indication of the water consumption of shopping centres. The benchmarks will be revised as more detailed audit data becomes available. The Department of Environment and Climate Change NSW is also developing NABERS retail benchmarks.

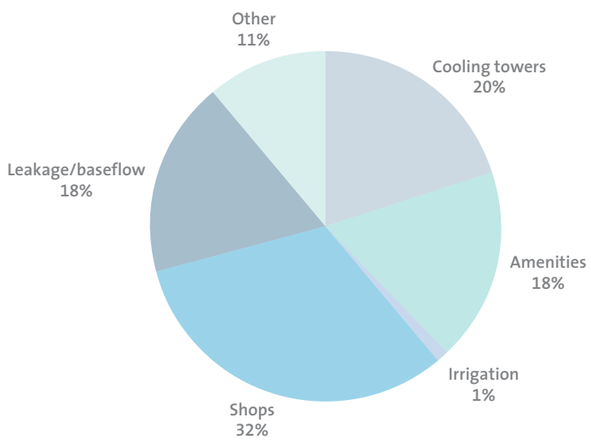


Figure 7 – Typical water distribution in a shopping centre, including leaks

Chapter 5

Benchmarking and building rating systems

Benchmark water consumption figures are a useful way to find out how water efficient your building is compared to others in the same industry. A benchmark helps you assess where there is room for improvement and if you can reduce your water use with cost effective measures. A benchmark can also confirm that your building is operating efficiently.

In addition to benchmark information developed by Sydney Water, there are several other environmental rating tools available for buildings. The three most common environmental rating tools used for commercial buildings in Australia are the National Australian Building Environmental Rating System (NABERS), Australian Building Greenhouse Rating (ABGR) and Greenstar.

NABERS

NABERS is a voluntary building performance rating tool. NABERS Office incorporates sustainability factors such as water consumption, energy consumption, solid waste generation and internal air quality. It also incorporates the ABGR system. NABERS Water assesses the water efficiency of buildings by allocating a star rating between 1 and 5 stars. 5 stars represents an aspirational target and 2.5 stars represents median performance. NABERS ratings are developed on the basis of a year's operational data.

For more information visit www.nabers.com.au/office.aspx

ABGR

ABGR system rates the energy use and greenhouse gas emissions of commercial buildings on the basis of a year's operational data. ABGR is now incorporated into NABERS Office so that building owners can measure both water and energy efficiency.

For more information visit www.abgr.com.au

Greenstar

Greenstar is a building environmental rating system run by the Green Building Council of Australia. Individual ratings offered by Greenstar include 'office as designed', 'office as built' and 'office interiors'. The tool is designed to recognise good environmental performance across all aspects of building design and all aspects of environmental impact.

For more information visit www.gbcaus.org

When looking at environmental rating tools for buildings you might also find reference to BASIX, LEED and CIRIA.

BASIX

The Building Sustainability Index (BASIX) is a regulatory tool that ensures improved water and energy efficiency when it is applied to new houses, home renovations and multi-unit dwellings in New South Wales. These buildings must achieve a certain level of efficiency before they can gain development approval. BASIX does not apply to commercial office buildings or shopping centres.

For more information visit basix.nsw.gov.au

LEED

Leadership in Energy and Environmental Design (LEED) is a standard developed in the United States of America for the design, construction and operation of high performance green buildings. LEED covers five areas of environmental impact: sustainable site development, water consumption, energy use, materials selection and indoor environmental quality.

LEED style rating systems operate in Canada, Mexico and India.

CIRIA Best Practice Indicators

CIRIA, a member-based research and information organisation dedicated to improvement in the construction industry, has developed best practice indicators for the water efficiency of offices and hotels in the United Kingdom. These indicators tend to be lower than Australian consumption benchmarks because of the lack of irrigation and cooling tower use in UK buildings. Adjusting for these uses, the CIRIA benchmarks are simillar to Sydney Water benchmarks.

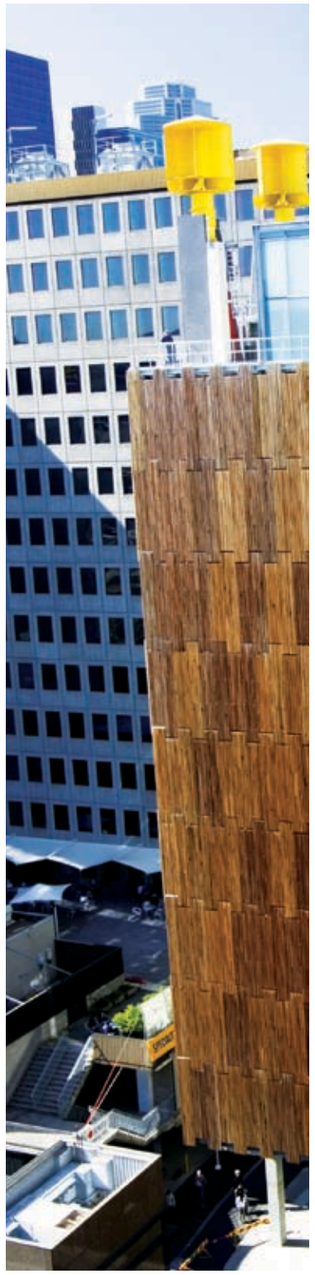


Table 5 – A comparison of ABGR star rating and energy consumption for a typical, Sydney office building

	Rating	MJ/m²	
		Electricity	Gas
Tenancy	1	659	73
	1.5	608	68
	2	556	62
	2.5	504	56
	3	452	50
	3.5	400	44
	4	349	39
	4.5	297	33
	5	245	27
Base building	1	801	89
	1.5	737	82
	2	672	75
	2.5	608	68
	3	544	60
	3.5	480	53
	4	416	46
	4.5	351	39
	5	287	32
Whole building	1	1456	162
	1.5	1340	149
	2	1225	136
	2.5	1109	123
	3	993	110
	3.5	878	98
	4	762	85
	4.5	647	72
	5	531	59

Note

ABGR is a dynamic rating tool that takes variables into consideration such as building location, hours of operation and density of computers. The data presented in this example is only accurate where the following assumptions are true.

Assumptions

Density of computers (m²/computer)	23
Hours of operation/week	50
Percentage of total building energy use that is electricity	90%
Percentage of total building energy use that is gas	10%
Building location	Sydney

Definitions

Tenancy – Office space within a building covering tenant light and power only. This may include tenancy air-conditioning if this has been installed to service particular tenant loads, but does not include central services normally provided by the landlord.

Base building – Central services and common areas of a building.

Whole building – A combination of the above which should include all energy entering the building used for providing services to the occupants of the space.

Chapter 6

The true cost of water

Water supply charges

Sydney Water charges business customers $1.339 for every one thousand litres (or one kilolitre) of water used. These water prices are likely to rise in the future due to the pressure of long term changes to rainfall and climate change, increased pressure on the environment and rivers and the need to invest in new water supply systems.

The real cost of water to a business is much higher than metered charges. It includes the costs of wastewater, trade wastewater processing and hot water.

Water service	Cost per kL
Water	$1.339
Wastewater	$1.296
Trade waste process charge	$0.574 (minimum)
Hot water	$3.131 (energy costs)

These figures are based on Sydney Water charges for 2007–08. Check with your local supplier for charges if you are outside Sydney Water's reticulated network.

Wastewater charges

Businesses that discharge more than 500 kilolitres of sewage a year, or 1.37 kilolitres a day, are charged $1.296 per kilolitre to reflect the costs of treating and managing wastewater.

Sydney Water uses a Sewerage Usage Discharge Factor (SUDF) to calculate the amount of sewage that you dispose of. The SUDF is the ratio of water going out of your business through the sewerage system compared to water coming in from Sydney Water's mains.

The SUDF applied by Sydney Water will depend on your business type and the equipment you have installed.

A Sydney Water study found that the typical SUDF for a reasonably water efficient commercial office building is 74 per cent. The same study found that a water efficient commercial building has a lower SUDF than an inefficient building. As water efficiency increases and water losses are reduced, there is an increase in the proportion of water lost to the atmosphere in buildings with evaporative cooling systems.

Inefficient buildings use a higher proportion of water in leaks or inefficient fixtures and this water is usually sent to sewer.

You can easily assess the efficiency of a building by calculating water use per square metre of lettable area (benchmarked or normalised consumption). This relationship has been demonstrated in building rating tools such as NABERs (refer Table 3).

If you have improved the water efficiency of your building and think this may have altered your current SUDF, Sydney Water can reassess your SUDF. You need to present Sydney Water with evidence that discharges to sewer are lower than calculated in your current SUDF. Gathering evidence may require additional sub metering and Sydney Water customers must meet this cost.

Calculating your sewerage charges

To calculate your sewerage usage changes, use the steps in the following example:

An office that uses 100 kilolitres of water a day and has a calculated SUDF of 90 per cent will discharge a sewage volume of 90 kilolitres a day. Charges will be applied after the first 1.37 kilolitres.

100 kL x 0.90 = 90 kL

Subtract 1.37 kilolitres from 90 kilolitres to find out the volume that will have charges applied to it.

90 – 1.37 = 88.63 kL

Multiply the chargeable volume by Sydney Water's sewage charges.

88.63 x $1.296 = $114.86

Daily water charges for the same building will be $133.90 (100 kilolitres x 1.339).

Daily water and sewer use charges will be $248.77.

Calculating your trade waste charges

Businesses that discharge greasy or oily wastes are charged trade waste disposal fees by Sydney Water to cover the extra costs of treating this wastewater. For example, a shopping centre using 100 kilolitres of water a day, with a calculated trade waste discharge factor of 75 per cent, will discharge a trade waste volume of 75 kilolitres a day.

100 kL x 0.75 = 75 kL

Multiply the chargeable volume by Sydney Water's trade waste process charges.

75 x $0.574 = $43.05

Daily trade waste charges will be $43.00.

The true cost of water

The true cost of water can far exceed charges for water and wastewater. Inefficient use of water can lead to excess charges for energy, chemicals, equipment and labour. Some companies have found that by taking these issues into account, the true cost of water can be up to four times its metered price.

Photograph 2 – Warragamba, the largest dam in the city's supply system, shows signs of stress after reduced rainfall

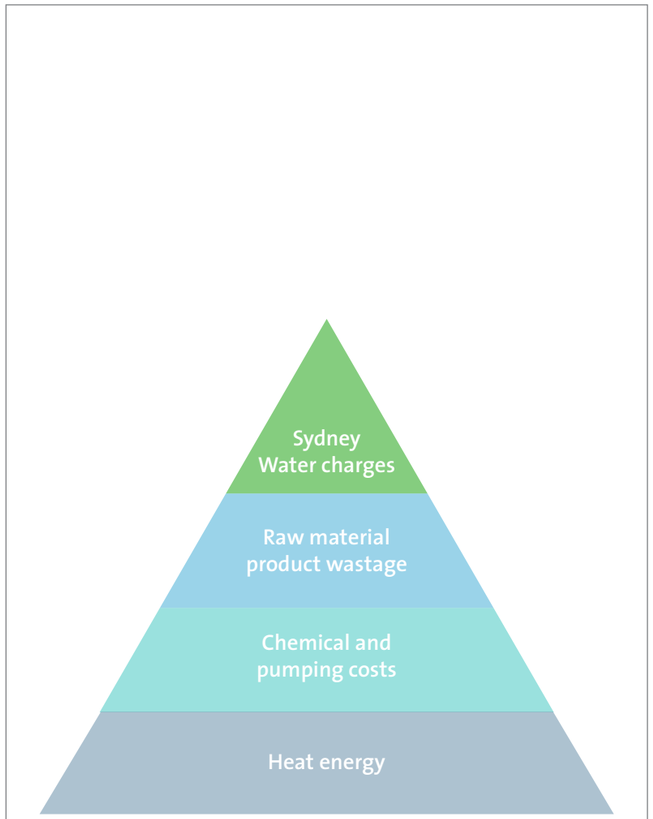


Figure 8 – The EDC Business Program 'Cost of water' pyramid highlights some of the hidden costs of water

Table 6 – Review of common operating and capital costs

Facility	Causes of water loss and related resource wastage	Costs
Heating, ventilation and air conditioning (HVAC)	**Water leaks from cooling tower** • water leaks from incorrectly set ball float valve or poorly designed hydraulic balancing layout • water loss from excessive drift, splash and bleed (poorly maintained anti-splash louvres) • leaks from poorly maintained cooling towers.	Water Sewage usage Energy Cooling tower chemical dosing
	Poorly designed HVAC systems • excessive water use in oversized cooling towers • heat loss from uninsulated duct work • lack of economy cycle – excessive operation of cooling tower • use of building cavities to transport return air instead of sealed ductwork will draw hot outside air into the building envelope and add to heat loads. • lack of variable frequency drives means no ability to tailor fan speeds to suit different cooling tower loads, and excessive operation of fans and chillers.	Energy Water Capital costs – replacing oversized HVAC equipment and oversized fans
	Poorly operated HVAC systems • failure to use economy cycle or vent with outside air – excessive operation of cooling tower • temperatures set too high/too low • no automatic HVAC controls – no ability to program thermostats, set timers or use energy management systems • dust and dirt on poorly maintained cooling coils will prevent efficient exchange of heat • dust in poorly maintained air filters will restrict air flow and efficiency • poorly located vents lead to hot and cool spots in building.	Energy Water Capital costs – replacing oversized HVAC equipment
	Excessive building heat loads • additional evaporation from cooling tower to reduce high heat loads - poor building location, orientation, design will make indoor air temperature susceptible to changes in outdoor temperature - poor building design will reduce ability to purge indoor heat – leading to excessive use of cooling tower - waste heat from inefficient lighting - waste heat from inefficient electrical equipment - waste heat from unused electrical equipment on standby • waste heat from electrical equipment not turned off after office hours - cooking equipment in commercial kitchens, food courts, restaurants - internal and external window shading • waste heat from product displays – lighting and electrical equipment • poor building entrances and ventilation leads to loss of cooled air and entry of outside heat.	Energy Water

Facility	Causes of water loss and related resource wastage	Costs
Water pumping and pressure jacking systems	**Poorly designed hydraulic systems** • pumping excessive water to upper storey storage tanks for gravity feeding fixtures and equipment • higher pressure leads to higher water consumption, including hot water use • damage to fixtures on lower floors from excessive water pressure	Energy Water Sewage usage Labour Capital costs in early replacement of fixtures damaged by high pressures Capital costs to replace oversized pumps, storage tanks and valves. Higher ongoing maintenance
Amenities	**Poorly maintained amenities** • toilet leaks from perished cistern seals • urinal leaks from malfunctioning sensors, poorly located sensors, broken solenoid valves • excessive flow rates in basin taps lead to excess water use, and energy use for hot water	Water Sewage usage Energy Excessive labour costs to maintain aging amenities
Hot water heating and kitchen equipment	**Excessive and inefficient hot water heating** • excessive energy required to heat water to higher-than-needed temperatures (reduce temperature to 60 °C for greater safety and efficiency) • leaks from hot water system lead to excess water and energy use additional cold water is required to cool excessively heated water to useful temperature • over-sink hot water boil units heat more water than is needed, adding to energy use and office heat load. If you use an auto-boil unit ensure it uses less than 50 Watts of standby power and is less than 2.5 litre capacity • inefficient dishwashers and glass washers use more water, more hot water and more detergent per cycle	Water Energy Chemical (detergent)
Fire service test water	• test water that's not reclaimed will end up as waste to stormwater whereas if could offset metered potable uses	

Responding to future water costs

As water prices increase in Sydney and other cities, business costs will also increase. Businesses that are already water efficient will be rewarded and increased charges will create greater incentives for others to further improve their water efficiency.

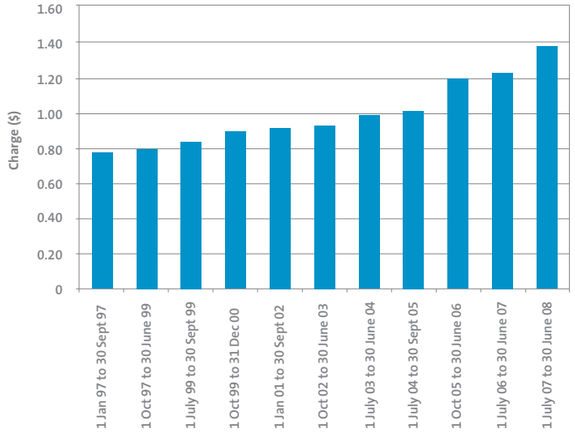


Figure 9 – Sydney Water's water use charges

Chapter 7

Funding water saving projects

Calculating the true cost of water in your commercial building can help build a strong business case for conserving water. By taking into account the total cost of water, many water saving projects are far more cost effective than first expected.

Many of the most effective water conservation projects will have simple paybacks – from several months to three years – making them excellent candidates for internal funding.

It can be difficult to internally fund an expensive or technically advanced water conservation project. If you need financial support for water conservation projects, some of the funding schemes listed below may help.

NSW Climate Change Fund

The NSW Government launched a five year $340 million program to fund energy and water efficiency projects in July 2007. The NSW Climate Change Fund includes:

- $30 million NSW Green Business Program for projects that will save water and energy in business operations in NSW within two streams – Market Transformation and Direct Measures
- $100 million Residential Rebate Program for energy and water efficient appliance rebates including hot water systems, insulation and increasing the rainwater tank rebate up to a maximum of $1500 and making it available across New South Wales
- $100 million Recycling and Stormwater Harvesting Program to assist in implementing the Sydney Recycled Water Grid
- $40 million Renewable Energy Development Fund for pilot and demonstration projects such as solar and geothermal power stations
- $20 million School Energy Efficiency program to upgrade lighting and implement student based energy efficiency projects
- $30 million competitive Public Facilities program for State and Local Government, educational and other community facilities to seek support for energy and water savings projects
- $20 million Rainwater Tanks in Schools program.

For more information visit http://www.environment.nsw.gov.au/grants/ccfund.htm

Low Flow Pre Rinse Spray Valve Program (Smart Rinse)

The Low Flow Pre Rinse Spray Valve Program, named Smart Rinse, will commence in 2007–08 and continue until 2009–10. During this time, Sydney Water will supply and install valves for commercial kitchens and restaurants, free of charge.

New models of low flow pre rinse valves have a flow rate of 6–7 litres a minute compared to a flow rate of 10–15 litres a minute in older models. The new models supplied have the same or better cleaning efficiency as older models and a 6 star WELS rating.

The Smart Rinse program is an effective way to cut water consumption and costs in commercial kitchens with no financial outlay.

Waterless Wok Subsidy – saving water in Asian restaurants

Installing a waterless wok can save a busy Asian style restaurant about five kilolitres of water a day. The Ethnic Communities Council (ECC) of New South Wales is offering subsidies and educational assistance to businesses in Sydney and the Central Coast if they install waterless woks.

If you would like a waterless wok for your restaurant or shopping centre food court, contact the ECC at wok@eccnsw.org.au

Australian Water Fund

Australian Government funding programs available through the Australian Water Fund are described below.

Community Water Grants help local community organisations, local government, schools, universities, childcare facility and health care organisations recycle or improve the health of their local water resources. Community Water Grants are not available for companies.

Water Smart Australia Program helps to accelerate development and uptake of smart technologies and practices in water use across Australia and is targeted at large scale projects. A funding priority is to increase urban, regional and rural water use efficiency and trial innovative or new technologies and practices.

For more information visit http://www.nwc.gov.au/agwf/index.cfm.

Chapter 8

Managing water better

The EDC Business Program has shown that improved management of water is the key to achieving sustainable water savings. Without better water management, technical improvements will only deliver short term changes to water conservation.

7-point plan

The EDC Business Program's 7-point plan for water conservation provides a useful framework for businesses to structure water conservation programs.

1. **Seek commitment and leadership from senior management**

   Commitment and leadership from senior management is essential to ensure a successful water conservation program. To achieve real results, management must take the lead in water conservation and set an example for their employees. Managers need to encourage changes in processes and behaviour to achieve sustainable water savings.

2. **Appoint a water conservation manager**

   Organisations that appoint someone to manage water conservation achieve better results. The person needs to have the dedicated responsibility for water conservation, although this does not need to be their sole task.

3. **Understand your systems to understand where your building is using water**

   Determine where, how and when water is used in your building. Audit water use, develop a balance between water entering and leaving the plant and identify the opportunities for saving water.

   Identify and quantify the hidden costs of water. Water costs are not only associated with supply and subsequent discharge to sewer.

   Saving water can lead to reductions in electricity, gas, labour and chemicals and identification of redundant water using equipment.

4. **Identify the opportunities to save water**

   Some of the simplest ideas for saving water may be the most cost effective, so don't be afraid to think laterally. Water conservation is not just about large scale technical solutions. Small changes can make a big difference. Ensure all staff have the opportunity to consider water saving ideas.

5. **Set a realistic conservation goal**

   It is important to have realistic conservation targets so that everyone can measure the gains. Businesses that conduct a water audit can typically identify annual savings targets of 20 per cent or more. Benchmark against key indicators such as kilolitres per square metre or litres per patron. Compare your benchmarks against those developed by Sydney Water and NABERS.

6. **Develop a conservation strategy**

   A conservation strategy needs to use the following principles:

   Avoid

   Avoid using water where possible.

   Reduce

   Where water use cannot be avoided, reduce the amount of water used. Reducing leaks is the most cost efficient option to minimise water consumption. Identify leaks as part of your regular maintenance program.

   Reuse

   If you cannot reduce the amount of water being used in a process, try to use the water more than once.

   Recycle

   Seek an alternative water source such as treated wastewater from another process, or treated sewage effluent where health guidelines allow.

7. **Involve your employees**

   Behavioural change will lead to sustainable water savings. Increase staff awareness of water conservation through signage, newsletters and posters. Tell staff why and how they can help both your business and the environment.

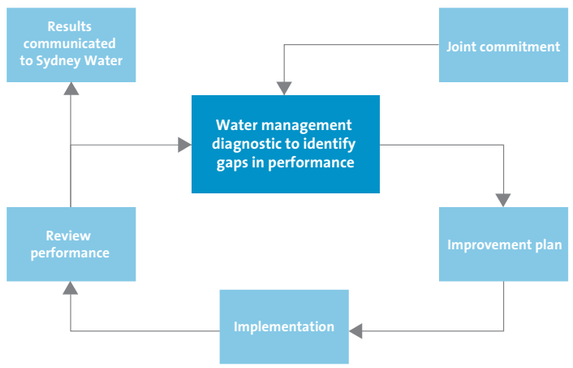


Figure 10 – The EDC Business Program process for helping customers save water, money and the environment

   Hold a competition to generate water saving ideas and reward staff for doing the right thing. Lead by example.

The 7-point plan is integral to the EDC Business Program's work to help large water using customers save water, money and the environment.

One-2-Five® Water – the power of the management diagnostic

Improving water management is a key element of the EDC Business Program. To help companies achieve better long term water management, the EDC Business Program conducts regular water management diagnostics for its customers. The diagnostics are known as One-2-Five® Water.

The One-2-Five® Water process is effective in ensuring sustainable water conservation. The EDC Business Program has shown that companies that have performed best in this diagnostic process are able to sustain water savings over the long term.

A management diagnostic

A management diagnostic is a process that analyses qualitative or non technical measures that all businesses must address to achieve sound water management.

Qualitative approaches to water management include:

- leadership and demonstrated corporate commitment
- understanding water use performance and opportunities
- planning using water use targets and key performance indicators
- identifying people with water management responsibility and accountabilities
- improving operational and maintenance practices
- supply management and legal compliance
- incorporating water into financial management
- technology and innovation
- measurement, verification and reporting.

One-2-Five® Water rating

The One-2-Five® Water management diagnostic tool is an essential part of the EDC Business Program. It helps businesses measure improvements in their water management and compare their performance with other organisations.

The One-2-Five® Water diagnostic tool uses a five star rating system to measure a company's performance in water management. The star ratings are defined as follows:

☆
Understanding water and wastewater regulatory requirements

☆☆
Basic water management practiced

☆☆☆
Water management system established

☆☆☆☆
Water management integrated into business systems

☆☆☆☆☆
Best practice and continuous improvement.

How do management diagnostics work?

One-2-Five® Water is a facilitated, self assessed workshop that helps a company assess its performance in essential aspects of water management. The company identifies management and operational measures that will improve water management.

For example, companies are asked to assess how well they comply with statements such as, "Water efficiency is addressed at facility management meetings and reports are given on the progress in achieving goals".

A typical One-2-Five® Water session takes one to two hours to complete and requires a cross section of staff to attend, such as facility, finance, operations, engineering and maintenance managers. The One-2-Five® Water diagnostic will provide:

- an assessment of the business's water management practices that can be used to benchmark performance against other similar organisations
- a targeted list of the barriers to improved water management
- an action plan that includes accountabilities and milestones.

Typical barriers to better water management

Tables 6 and 7 show critical actions identified in the initial One-2-Five® Water session and review sessions to address barriers to improved water management. Results from initial and review diagnostic sessions show that as businesses improve their water management, the focus on water management changes.

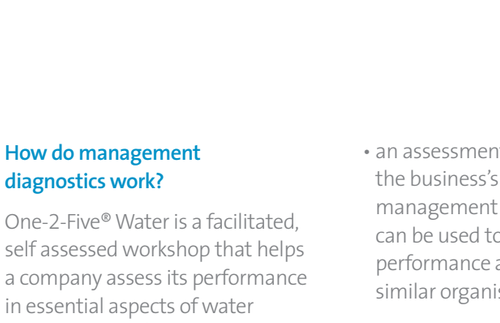


Figure 11 – A higher One-2-Five® Water star rating for Macquarie Real Estate Capital's commercial Sydney buildings has influenced a reduction in its water consumption.

In initial One-2-Five® Water sessions, the focus is on gathering information, obtaining management commitment and developing management structures. In review sessions the focus changes to improving the quality of information and how the information is documented and communicated.

In tables 6 and 7, the elements and actions are listed in order of the frequency with which they occur.

The actions most commonly recommended in the EDC Business Program review diagnostics of 22 commercial property companies are shown in Table 10. The elements and actions are listed in order of the frequency with which they occur.

Water management in your business

Consider how your business has encountered or overcome some of the barriers to good water management described in Table 7.

Will undertaking the critical actions listed help you overcome these barriers? How else can you work within your existing business structures to overcome barriers to water management?

Table 7 – Elements and critical actions identified in initial One-2-Five® Water management diagnostics that have been completed in Sydney's commercial property sector.

Element	Recommended critical actions
Understanding of performance and opportunities	Conduct a water and wastewater audit or baseline study to establish: • assessment of trade waste legal compliance status • water and wastewater efficiency opportunities • leakage from reticulation system • total water use per production unit
Targets, key performance indicators (KPIs) and motivation	Set overall cost and/or volume reduction targets that specifically incorporate water savings
Demonstrated corporate commitment	Develop a policy, eg environmental, with specific goals for improving water efficiency and have your Chief Executive Officer or Operations Director sign it
Reporting, feedback and control systems	Develop regular water efficiency reporting that highlights variances in water use compared to targets at cost centre levels
Metering and monitoring	Meter water usage for water intensive operations
Water supply, quality and reliability	Review your treatment and reticulation systems when refurbishing or installing new plant to ensure that supply volume, pressure and quality requirements can be met under maximum demand conditions.

Table 8 – Elements and critical actions identified in review One-2-Five® Water management diagnostics completed in Sydney's commercial property sector.

Element	Recommended critical actions
Reporting, feedback and control systems	Develop regular water efficiency reporting that highlights variances in water usage versus target at cost centre levels
Understanding performance and opportunities	When assessing the benefits of water efficiency improvements, include the operating costs associated with water bores, pumps, pipelines, chemicals, treatment and heating, etc
Compliance with legal and other requirements	Integrate water management compliance issues in your risk management plans, including quality, environmental, occupational health and safety
Targets, key performance indicators (KPIs) and motivation	Develop a process for updating water efficiency targets when there are significant changes to your operations.
Water supply, quality and reliability	Capture natural site drainage and stormwater for reuse, where cost effective
Metering and monitoring	Display and track water performance indices by using existing process control systems.

Chapter 8 – Managing water better 1

Case study
The GPT and Jones Lang LaSalle journey to 5-star

The GPT Group and Jones Lang LaSalle (Asset Management Services) (JLL AMS) have achieved a 5 star rating in the One-2-Five® process. During 2005–2007, water use in their top five Sydney buildings was cut by more than a third. In their Citigroup Centre building which is half owned by Macquarie Office Trust, water use was cut by 51 per cent in the same period.

The GPT Group is one of Australia's largest diversified listed property companies with total assets of approximately $12 billion and 800,000 square metres of lettable floor area. JLL AMS is property manager for The GPT Group's Office Portfolio.

GPT and JLL AMS are the second commercial property customer in the EDC Business Program to achieve a One-2-Five® Water management 5 star rating. As at November 2007, only three companies in the world had achieved this star rating.

GPT and JLL AMS have established key performance indicators and aggressive water reduction benchmarks and targets across their whole portfolio, including buildings in other states of Australia.

They have set a 2007 portfolio target of 1.17kL/m²/year which is 10 per cent less water used than in 2006.

The GPT and JLL AMS journey to 5 stars began in May 2005 when the companies signed a memorandum of understanding with the EDC Business Program. Resource efficiency had always been a priority for the two companies but they recognised they could improve more quickly by taking advantage of the assistance and resources of the EDC Business Program.

The first step in the journey to 5 stars was to conduct a water management diagnostic to determine the state of their water management systems and assess how they could be improved. The companies achieved an initial rating of 2 stars and five critical actions were identified:

1. Perform a detailed assessment of water savings available at each water intensive facility
2. Set water efficiency targets for facilities based on a savings assessment and benchmarking
3. Include legal compliance requirements in the induction program for all relevant staff and contractors
4. Develop regular water efficiency reporting that highlights variances in water usage versus target at cost centre levels
5. Meter water usage for water intensive operations.

The critical actions were completed quickly and a review diagnostic and audit were conducted by the Sydney Water contractor Energetics. The companies shot straight to 5 star.

The challenge for GPT and JLL AMS is to maintain this level of water management and continue to reduce benchmark water consumption.

The structured process of the EDC Business Program helped to promote cultural transformation of water management at GPT and JLL AMS, with emphasis on:

- understanding water use performance and discovering opportunities for conservation
- involving management and operations staff in water saving projects
- improving water use data, reporting and benchmarking
- completing and implementing NSW Government mandated Water Savings Action Plans
- continual improvement
- improvements in water management should be sustained for the future.

Photograph 3 – The Citigroup Centre Building at 2 Park Street Sydney, co-owned by Macquarie Office Trust and The GPT Group, has reduced its water use by 51 per cent since 2005.

Chapter 9

Monitoring water use

Regularly monitoring water use is the key to any successful maintenance schedule and any successful water saving program.

It is almost impossible to save water if you don't know how much you are using, where and when it is being used and where your best opportunities for water savings exist.

Monitoring – the key to identifying water savings

Monitoring water use enables you to understand your water use patterns and discover leaks and inefficiencies.

Without monitoring, leaks can remain undetected because most wastewater goes directly to sewer. This means you pay unnecessary water and wastewater charges. If you have leaks in your hot water services you will pay unnecessary energy bills.

Installing sub meters

To get the most out of your monitoring program you need to install sub meters throughout the building. The sub meters help you understand where and how water is being used.

The EDC Business Program suggests that you prioritise the sub metering of your commercial premises, as follows:

Priority 1 – cold water supply

Sub meter the supply lines that service the different areas of the commercial building. In some buildings, water is pumped to a tank to supply water to the upper storeys. You can identify any overflows in the tank supply by comparing the tank's measured outflow to the main meter readings.

Priority 2 – hot water supply

Preventing hot water waste and leaks saves money, water and energy.

Priority 3 – amenities

Toilets and urinal systems can use large amounts of water and are often the source of leaks. Monitoring amenities can also provide

feedback on the success of leak reduction programs and improved maintenance and cleaning practices.

Priority 4 – cooling towers

Monitor the make-up water into a cooling tower. You can also install a sub meter on the bleed line. A meter on the bleed line will help establish a SUDF but you must make sure the meter is suitable for dirty water.

Priority 5 – food courts and restaurants

Water use in food courts and restaurants can be measured against the number of meals prepared to generate water use benchmarks and identify leaks and inefficiencies.

Priority 6 – outdoor areas and water features

Monitor the water supply to your irrigation system and water features because outside leaks can easily be missed.

Priority 7 – retail shops

Measuring the amount of water used by retails shops is essential in commercial buildings. Accurate sub metering of each business allows you to pass water charges on to tenants according to their use. This gives them a direct incentive to save water.

Priority 8 – sewer discharge

Monitoring sewage discharge will help to identify the amount of sewage discharged from a building compared to the SUDF calculated by Sydney Water. If your sewage discharge is radically different from the SUDF calculated for a building of your type, you may have a leak. Sydney Water studies have shown that efficient buildings have a lower SUDF than inefficient buildings because more water is lost to evaporative cooling and less water is lost to leaks and disposed to sewer.

Manual monitoring

If you don't have an automatic monitoring system you can keep track of water use with manual readings. You should read the meter when the commercial building is closed at the end of the day's trading and again the following morning.

Ideally, meter readings should be very similar. If there is a large difference in readings and no activities occur at night, leaks need to be investigated and fixed. Overnight flow is often caused by leaking amenities or cooling towers.

Automatic monitoring systems

A continuous monitoring system is a more efficient way to monitor water use and keep track of multiple sub meters. Continuous monitoring systems save time, identify your water use patterns and make it easier to identify unusual water use. In most systems, water use is recorded at least every 15 minutes, giving an excellent picture of water use.

Data loggers

Simple continuous monitoring systems operate as data loggers. The information they gather must periodically be manually downloaded to a portable computer so that you can analyse the data. These systems are relatively inexpensive and give good information. The information is not instantaneous and you still have to download and analyse it.

Continuous online monitoring

Your business can choose to pay a fixed charge for data that is available through the internet. Your service provider will install a data logger on nominated sub meters and data will be sent to their computer servers via a mobile phone network. You should be able to access the water consumption information from any computer with internet access. The system can be programmed to alert you via email or SMS if there are dramatic changes in water use or increase in base flow.

If you want to establish an online monitoring system for your building you will have to pay an upfront cost to set up the system and a smaller annual service charge. Costs will increase with the number of sub meters monitored and the complexity of your building.

There are great advantages in being able to access data from any computer and being able to identify problems as soon as they emerge. You can save money in equipment maintenance and upgrade costs.

Using your building management system

You can use your existing building management system (BMS) to continually monitor water use. Talk to the supplier of your current building.

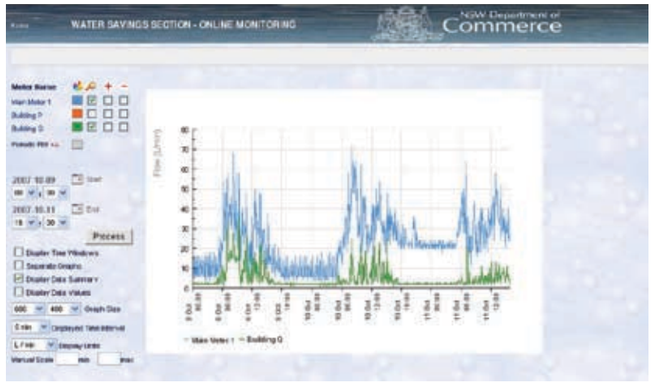


Figure 12 – A system such as the online water monitoring tool developed by NSW Department of Commerce is a valuable asset for good water management.

management system about whether they can connect water meters to your computerised BMS. The costs of running cable through an existing building will depend on the complexity of your hydraulics and building layout.

Using your BMS can enables you to consolidate the monitoring of all utilities (ie water, gas and electricity) into a single system. This gives you a snapshot of current use so you can compare it with your history of consumption. Having this information at your fingertips helps you efficiently manage utilities because you can:

- spot discrepancies in water use during or immediately after the event and respond appropriately
- track consumption and obtaining the data to justify water and energy conservation projects
- monitor energy and water key performance indicators (KPIs) in the building or sections of the building
- improve documentation so that you can back charge tenants for use of utilities, get an indication of previous utilities charges, or present evidence for legal disputes.

Graphing water use data

If you choose to graph your monitoring data you will have instant visual information about your water use. This makes it easy to identify patterns and changes. Graphs can be used as business performance indicators and are a good way to communicate water conservation messages to tenants and staff.

Water balance

A water balance is a key piece of information to include in a water efficiency audit. It helps you see where water is being used in your building and allows you to compare water intake with water discharged.

You can develop a water balance using information from regularly monitored sub meters. If you monitor water discharged to sewer, you can develop a comprehensive water balance and accurately identify losses due to leaks.

To understand where water is used and how it is distributed, draw a diagram of the water system. The diagram should include water used by cooling towers and losses due to bleeding, evaporation and drift. If you use a pie chart (eg Figure 10) you can easily see how much water used in different parts of the building and how much is discharged to sewer.

Once you have calculated and graphed your water balance, it is far easier to determine your best opportunities for saving water.

Figure 13 – A typical hydraulic system for a commercial office building shows suggested locations for sub meters. Once installed, these sub meters will allow an accurate water balance to be developed

Chapter 10

Water efficiency audits

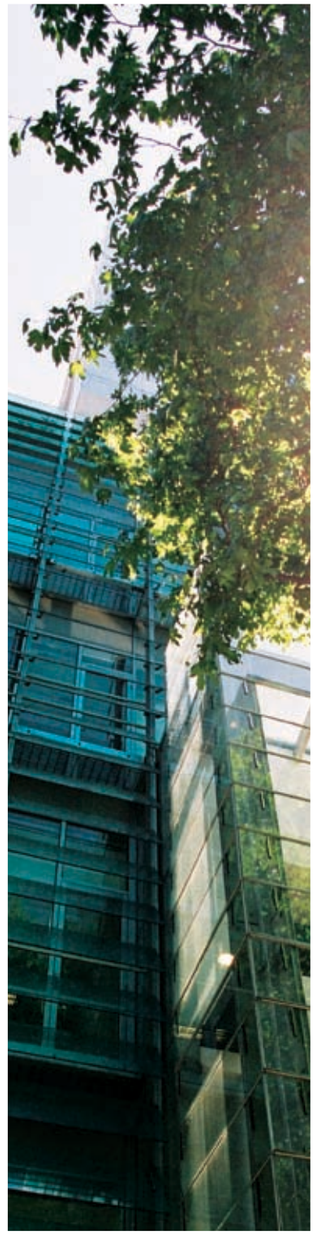
When you have an efficient water usage monitoring system, the next step in establishing a business case for water conservation is to carry out a water efficiency audit.

Key objectives of a water efficiency audit are to:

- identify water use patterns
- understand the water supply system
- identify deficiencies in the system, including leaks and wastage
- identify water and energy conservation opportunities, including water reuse
- benchmark water and energy use
- develop water and energy use targets.

To conduct a water audit you need to:

- locate up to date hydraulic plans that identify water, wastewater and stormwater reticulation pipe networks
- inspect access to the water pipe network, water services, existing meters and sub meters and tanks
- use flow tests to identify flow rates and inefficient water fixtures
- identify and recommend locations for new sub meters
- install logging equipment on meters and sub meters and begin logging
- monitor sub meters that use more than 10 kilolitres a day or 15 per cent of water used in the building
- calculate the net area of the building, the net lettable area (especially for commercial office buildings), the gross lettable area (especially for shopping centres), the number of levels and the size of the landscaped area
- calculate patronage and visitation and identify the building's hours of occupancy
- review cleaning practices in the building
- review and understand water use patterns
- understand operational and maintenance practices, including water use, reactive procedures, training, signage, etc



- identify base flows, leaks and inappropriate water use
- review main water meter sizing
- develop a water balance
- calculate water and sewage charges
- review water reuse or recycling and identify future projects
- identify your best water saving opportunities and prioritise these opportunities according to simple payback or internal rate of return calculations.

KPIs and targets

It is important to identify water use key performance indicators (KPIs) for your building and set reduction targets. The most common KPI for commercial office buildings and shopping centres is kL/m²/year. You may also want to measure litres per patron per day (L/patron/day).

Best practice water use for shopping centres and commercial office buildings is shown in Chapters 3 and 4 of these guidelines. You can use these benchmarks to set targets for water conservation. You can also set targets by subtracting identified water savings from your current water use.

The following example of a calculated benchmark is from a shopping centre:

Baseline water consumed (averaged over five years)	519 kL/day
Gross lettable area	96,500 m²
Patrons a day (average from annual figures)	35,100
KPI L/m²/year	**1.96**
KPI L/patron/day	**14.78**

These figures indicate that the centre is performing below the median market value. After conducting a water efficiency audit, savings of 126 kL/day were identified.

Potential water savings identified	126 kL/d
Target water use	393 kL/d
Target KPI L/m²/year	**1.48**
Target KPI L/patron/day	**11.1**

By fixing leaks, adjusting and repairing cooling towers, improving cleaning practices and installing more water efficient amenities and kitchen equipment, the shopping centre could significantly improve its performance.

Micro targets

Water use targets can also be identified for each operation or piece of equipment identified in the audit and schematic. Examples of micro KPIs are shown below.

Fixture/Area	KPI
Amenities	L/patron/day
Cooling Towers	kL/day
(to avoid the impact different seasons have on cooling tower water consumption, you may need to measure kL/year)	
Hot Water	L/patron/day
Kitchens	L/patron/day or L/meal(cover)/day
Cafés	L/tables/day

Setting targets for each part of the building can help you and your tenants aim for relevant water conservation goals and measure progress. If you are sub metering and charging these businesses, KPIs help tenants understand their opportunities for water and cost savings.

Action plans

When you have identified where water is used and savings opportunities, it becomes easier to calculate the investment required for each opportunity and the expected financial returns. This helps prioritise your water conservation investment.

Each business can decide its own priorities for water conservation. This decision will usually be made by considering:

- cost saving opportunities
- water savings and environmental benefits
- customer and tenant demand
- funding availability
- legal requirements
- tenant, customer and management support.

Once priorities are understood, a water saving plan with clear objectives and targets can be developed.

Formal processes for setting action plans are a key part of the EDC Business Program. Large water using businesses in the Sydney region are also required to complete a Water Savings Action Plan.

Review your progress

It is essential to review your water conservation progress so you can assess:

- how much water you have saved
- how your water savings have affected your KPIs
- the costs and benefits of your actions
- successes and failures of water saving projects.

A review will help you prioritise water savings and ensure that water conservation is an ongoing emphasis for your business, not an ad hoc process.

The process of continual improvement is a key element of the EDC Business Program.

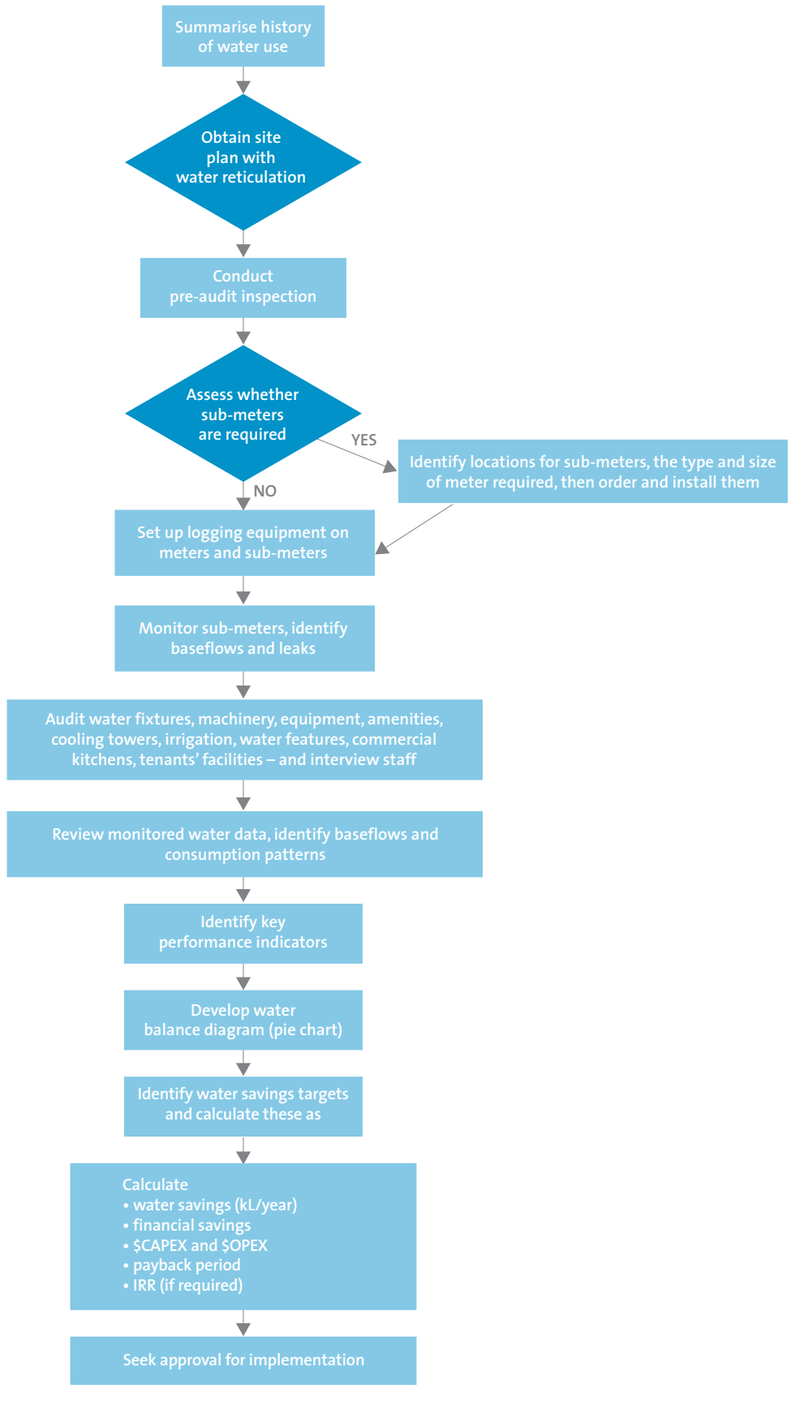


Figure 14 – The systematic approach that should be applied when conducting a water efficiency audit in a commercial building.

Chapter 11

Waterwise education

Education and good communication are vital elements of an effective water management system. Most people in New South Wales are aware of the importance of saving water (DECC, 2007) so it makes sense to let all your tenants, employees and visitors know what you are doing to save water and how they can help. This can boost staff morale and have a positive influence on the perceptions of building developers, owners and managing agents.

Many companies are also including water conservation in their environmental policies and will only lease office space if it meets minimum environmental standards.

Many government departments and large corporations have environmental policies that require them to reduce the environmental impact of their operations and choose environmentally high performing office space. Government tenants account for up to 30 per cent of the commercial office market in major cities such as Sydney. Without implementing measurable water efficiency measures in your portfolio, you will miss out on this important market segment.

Tools for including your tenants and workforce in water conservation campaigns include:

Green leases

Green leases mean that the commercial relationship between owner and tenant is based on sound environmental principles from the beginning.

The green lease is a precedent lease (one that all tenants sign). It sets out the mutual obligations of the building owner and the tenant to achieve environmental improvements. Tenants choose whether or not to agree to meet these obligations.

The benefits of a green lease for building owners include opportunities to attract tenants by reducing operational costs and generating more appealing buildings to work in.

Tenants have an incentive to participate in environmental programs because savings from improved efficiency are passed on. As of November 2007, Investa is the only company in the Australian property market to introduce a green lease arrangement.

Public benchmarks

Setting and achieving water consumption targets is a good way to demonstrate your corporate commitment to the environment. Publishing these water consumption targets and achievements will help environmentally aware tenants differentiate your building from others.

Companies such as Investa and Stockland agree that setting transparent targets is a key for maintaining market confidence and inspiring improvements in office performance. Investa has built a strong reputation for environmental management. It was the first Australian commercial property company to set and meet public water consumption benchmarks for its buildings.

Keep tenants informed

Tenants and staff are generally keen to improve the environmental performance of their workplace, but often do not have access to information that enables them make a difference.

You should ensure that everyone in the building knows the basics

of how your water and energy conservation program works. They need to know who to call to report a leak or any other building performance problems, and where the light switches are so they can turn them off in the evening. Create ways for people to offer constructive suggestions for improved building management, such as a dedicated email address, webmail or even a suggestion box that is regularly read. Ensure that property supervisors promptly fix reported leaks and respond to reports and suggestions.

If your building has newer environmental design features, such as user operable louvres or adjustable air vents, make sure all tenants know how to use them properly. This information can be provided with new leases or by property managers at regular tenant and staff briefings. There can also be permanent signage throughout the building.

In new buildings, make tenant feedback a part of the long term commissioning process.

Fix leaks quickly

Allowing leaks to go unfixed or failing to replace old, leaky equipment will quickly undermine your water conservation credentials. Conversely, a responsive maintenance team that makes sure water is not wasted will reinforce perceptions that building owners are environmentally responsible and care about water conservation.

Sub meter and charge for consumption

Sub metering each tenancy in your building means that owners and tenants can see the impacts of their water consumption habits. It gives tenants a financial incentive to become more efficient, develop benchmarks and monitor water consumption against business production or turnover.

Charging tenants according to their consumption also prevents unfair cross subsidies that occur when water and energy bills are split proportionally amongst tenants, regardless of whether they are water savers or water guzzlers.

If you intend to charge tenants for water consumption, you should state this in the lease. You need to explain how outgoings will be measured and how charges will be calculated and recovered from the tenant.

Provide information feedback

It's easier for people to modify their behaviour if they receive relevant information and feedback. Some companies install screens in their office that display latest information about the building's energy and water consumption and its progress against environmental targets. Other companies make sure that graphs of energy and water use are regularly emailed to staff. This information allows staff to evaluate and modify their behaviour, as individuals and as a team.

If you want to run awareness programs and are an EDC Business Program customer, the following resources are available:

Save it sticker

Fill in the phone number of your plumbing maintenance staff and place this sticker in bathrooms so that staff or visitors can report leaks before they become big problems.

Save it sticker – Chinese

This sticker allows you to communicate water conservation messages to Chinese speaking visitors and tenants.

Shower hangers

Remind staff that a one minute shorter shower today saves nine litres of water for tomorrow. Co-branded shower hangers can be developed for EDC Business Program customers.

Posters

EDC Business Program customers can receive a range of co-branded water conservation posters. The posters can be displayed in amenities and staff rooms and near other water using equipment.

WaterFix and DIY Retrofit

Sydney Water offers residential customers the chance to participate in WaterFix where a licensed plumber installs an efficient showerhead and flow restrictors in your house. Residential customers can also participate in DIY Retrofit where they can install a free packet of flow restrictors on their existing showerhead and household taps.

Sydney Water has a rolling program to distribute DIY kits and promote WaterFix in shopping centres. You can promote these programs to staff, in partnership with Sydney Water.

Case study
Mandarin Centre – water efficient tenants

The Mandarin Centre in the Sydney suburb of Chatswood has been monitoring on-site tenant communication and financial incentives to help tenants reduce water consumption.

The Mandarin Centre installed a customised monitoring system in 2006 and now directly monitors the water consumption of individual shops in the centre and charges tenants for their water use. New tenants must submit a list of proposed equipment to Centre Management and only water efficient units are approved. For example, if a new restaurant is to be opened and a wok stove is on the proposed list of equipment, it will be rejected unless the wok stove is a waterless wok.

Several times a day, the Mandarin Centre conducts random inspections on the largest water users in the centre. These inspections ensure that all staff observe water efficiency practices and understand that Centre Management takes water conservation seriously.

Photograph 4 – The Mandarin Centre in Sydney's north shore suburb of Chatswood, managed by the Paragon Group, requires water efficient equipment as part of all new tenancy fit outs.

References

Who Cares About the Environment 2007, Department of Environment and Climate Change NSW.

Green Lease Guide for Commercial Office Tenants 2006, Investa Property Group, Department of Environment and Climate Change NSW, City of Sydney Council, City of Melbourne Council and the Institute for Sustainable Futures.

Part 2

Technical water saving information

Part 2 of **Best practice guidelines for water conservation in commercial office buildings and shopping centres** provides the owners and managers of all commercial buildings with practical information on how to implement water conservation projects.

Chapter 12

Identifying and fixing leaks

The priority in any water saving campaign should be to fix leaks. In commercial office buildings audited by the EDC Business Program, an average of 28 per cent of water used was wasted by leaks.

If your commercial building uses more than 1.01 kL/m²/year, it probably has leaks. You should investigate and fix these leaks immediately, using information in Chapter 9 to help you undertake a good monitoring program.

Leaks can be detected when regular monitoring shows a rapid and unaccounted increase in water use. If a leak has been occurring for a long time, you might need overnight or continuous monitoring may be needed to identify base flow.

Leaks from pipe breaks may be hard to identify because they can discharge to stormwater rather than sewer.

In one business, leaks accounted for 80 per cent of total water use. As this business always compared its water bill was with the previous bill, the leak was not identified until a detailed water efficiency audit was conducted. This example emphasises the need for overnight and continuous monitoring.

Hot water

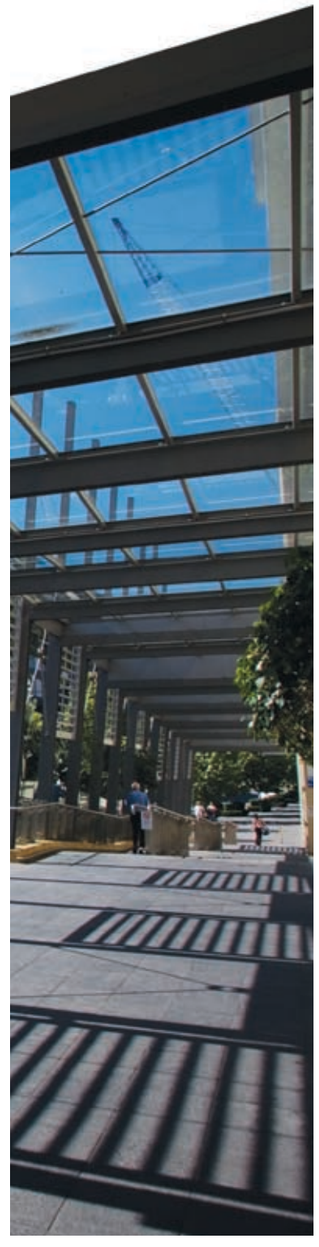
Leaking hot water from showers, basins and kitchens can cost thousands of dollars a year in water and energy. Every kilolitre of wasted hot water costs up to $6.34 if you take into account the costs of metered water, wastewater and trade waste discharge and heating.

Leaks in hot water services will artificially boost your hot water demand. If leaks are not identified you will probably install oversize hot water systems, leading to additional capital and operating costs.

Maintenance

Regular maintenance is the best way to prevent leaks in water using equipment. Maintenance should focus on urinal sensor flush units, taps, showers and cooling towers.

It is more cost effective to replace washers and seals once a year and not wait for an inconvenient and costly water leak to occur.



Chapter 13

Saving water in amenities

Amenities account for 25–33 per cent of water used in office buildings and shopping centres. This means there are great opportunities to achieve impressive water savings with low cost, easy to implement measures that have very short payback periods.

Depending on the mix of tenants and activities in shopping centres and commercial buildings, amenities can account for up to 40 per cent of total use.

Taps and showers

In some buildings, taps in hand washbasins run at 12–20 litres a minute. Flow can easily be restricted to six litres a minute or less by installing flow restrictors that achieve a WELS 3 star rated flow. Taps with a flow as low as 1.9 litres a minute are available.

Sensor activated taps will stop taps being left running and improve hygiene. Sensor taps require regular inspection to ensure that the sensor unit works soundly and cuts off when required. Make sure that flow through the taps is still less than six litres a minute.

Most commercial office buildings will have several showers, even if they are located in hard to find spaces. Older showerheads typically have a flow of 15–20 litres a minute. Installing flow restrictors will reduce the flow to nine litres a minute or less. Old showerheads can also be replaced with WELS 3 star rated showerheads.

Toilets

Replacing just one 11 litre single flush toilet with a 4.5/3 litre dual flush toilet can save 140 kilolitres of water every year and $352 in water and wastewater costs.

If you have not replaced all old toilets with dual flush models, it is possible to reduce toilet flush from 11 litres to nine litres by adjusting the float level in the toilet cistern. It isn't recommended to reduce the flush much more than this because old toilet pans aren't properly designed for low volume flushes and the toilet pan may not clear properly after each flush.

According to the Water Efficient Labelling Scheme (WELS) the average water consumption of toilets must not be more than 5.5 litres a flush. The average water consumption of a dual flush cistern is taken to be the average of one full flush and four half flushes. This means that dual flush 9/4.5 litre toilets are now the least efficient products that can be purchased and installed.

If you are using very low flush toilets (such as 4.5/3 litre dual flush models) it is wise to consider how steeply pipes drain and the quality of consumables, such as toilet paper. Very poor quality toilet paper may not flush well in ultra low flush toilets. This can cause blockages in the pan and pipes.

Vacuum toilets can also be used for amenities that are connected directly to sewer systems. Water

consumption is about 0.5 litres a flush. A vacuum system requires a pump to create the vacuum. One pump can service a number of toilets in a commercial building and can be located in a different room or in the ceiling space. Vacuum toilet units look similar to traditional flushing toilets and installation costs are comparable.

Composting toilets are more common in Europe and North America than in Australia. They eliminate the need for water and the creation of black water and if well maintained, they create sterile humus and do not smell. Thought needs to go into the design and maintenance of composting toilets if they are used in new buildings, as the space needed to operate them may be excessive for standard CBD commercial buildings. Composting toilets may be more appropriate for campus style buildings that have committed and well educated staff.

Urinals

Cyclic flushing urinals are very wasteful and should be immediately replaced with on-demand, sensor or manual flushing systems.

When installing urinal sensors, ensure that manual shut off valves are included so that any malfunction with the flushing unit does not cause continuous flushing. Urinal sensors can waste water if they malfunction, or if they are set to detect normal bathroom traffic. Inspect and adjust sensors so that they only flush when someone has used the urinal. Replace batteries on urinal sensors regularly as flat batteries can lead to constantly flushing urinals.

All urinals need routine maintenance and adjustment to function properly and be water efficient. You can install urinals so that the cistern does not act as a break tank. This will help you identify any leaking solenoids. When you are replacing amenities or fitting out new buildings, use highly efficient urinals with a WELS rating of 5 or 6 stars, or waterless urinals.

The Sydney Water fact sheet *Waterless Urinals* describes the different types of waterless urinals available and steps you should follow to ensure successful installation. You can get a copy of *Waterless Urinals* from the EDC Business Program team or download it from www.sydneywater.com.au.

Staff amenities

Maintenance of staff-only toilets and taps can be a low priority for maintenance staff because they aren't subject to public scrutiny, but leaks and water wastage cost money. If you do not fix leaks and inefficient equipment in staff areas it will convey a lack of commitment to water conservation by building managers.

Sydney Water's *Save It* stickers are a good way to encourage staff to report leaks to plumbing or maintenance staff. If you are an EDC Business Program member you can get printed stickers from your project officer.

Maintaining amenities

An active maintenance program is essential to detect leaks and broken amenities. Good maintenance is often the cheapest and most effective way to save water. Make sure building users know how to contact maintenance staff or plumbers to report leaks and other problems.

Taps and showers

In some buildings, taps in hand washbasins run at 12–20 litres a minute. Flow can easily be restricted to six litres a minute or less by installing flow restrictors that achieve a WELS 3 star rated flow. Taps with a flow as low as 1.9 litres a minute are available.

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Toilets

Replacing just one 11 litre single flush toilet with a 4.5/3 litre dual flush toilet can save 140 kilolitres of water every year and $352 in water and wastewater costs.

Case study
Fixing urinals saves money

In one commercial office building owned by an EDC Business Program customer, a desktop review of water use showed a 231 per cent increase in water use over six months.

The rise from 70 to 162 kilolitres a day couldn't be explained by any changes in building use, equipment changes or occupancy. After a complete site inspection, the facilities manager discovered that eight urinals were continuously flushing because solenoid valves were failing to seal closed.

Over the six months that the leak was occurring, building owners paid an extra $60,000 in water and sewage charges. If a maintenance and monitoring system had been in place these charges could have been avoided and more than 16,000 kilolitres of water saved.

Case study
Saving water by retrofitting amenities

Sydney Water's Business Retrofit Pilot Program demonstrated that improving the efficiency of amenities can lead to big water and cost savings in commercial buildings.

Commercial buildings and shopping centres represent 24 of the 52 sites involved in the Retrofit Program. Participating building owners all received pressure compensating flow regulating devices. Amenities covered in this program included:

- bathrooms – basin taps, urinals, toilets
- staff kitchens – sink taps
- staff change rooms – showers, basin taps.

The building managed by Jones Lang LaSalle in Sydney is a 28 storey office block with retail tenancies and a café on the ground floor. During the Retrofit Program, the building's amenities were audited and retrofitted with a combination of tap aerators and flow regulators. The building was free of leaks before the amenities retrofit began and the number of occupants in the building did not change after the retrofit.

The reduction in flow rates as a result of the program were:

- 20 L/min to 2 L/min in basin taps
- 20 L/min to 5 L/min in kitchenette sink taps
- 20 L/mins to 9 L/min in showers.

The volume of water in all toilet cisterns was also reduced from 10 litres to 7 litres.

After installing all the equipment and reducing toilet flush volumes, the building's water consumption fell by over 100 kilolitres a day compared to the same period in previous years. These figures represent a remarkable drop of around 45 per cent in total water usage onsite.

Ian Bentley, the Building Engineering and Operations Manager, said, "I now have the proof that what we are doing is worthwhile, not just in terms of the environment but also in real financial terms."

Photograph 5 – Ian Bentley, Building Engineering and Operations Manager, Jones Lang LaSalle.

Case study
Amenities in shopping centres

Public amenities in shopping centres require regular routine maintenance because of their high usage levels. High patron use means that water efficiency measures are often very cost effective.

Shopping centres may also contain tenants such as gymnasiums that have showers, toilets and hand basins that are frequently used. A large gym in a shopping centre audited by Sydney Water used 35 kilolitres a day, or nearly 15 per cent of the centre's total water use.

It is important to include these tenants in the centre's routine maintenance, monitoring and retrofitting programs.

Table 9 – WELS rating specifications for tapware

Rating	Specification (L/min)
0 Star	> 16
1 Star	> 12 and < 16
2 Star	> 9.0 and < 12
3 Star	> 7.5 and < 9
4 Star	> 6 and < 7.5
5 Star	> 4.5 and < 6.0
6 Star	< 4.5

Table 10 – WELS rating specifications for toilets

Rating	Specification (L/average flush)
0 Star	N/A
1 Star	> 4.5 and < 5.5
2 Star	> 4.0 and < 4.5
3 Star	> 3.5 and < 4.0
4 Star	> 3.0 and < 3.5
5 Star	> 2.5 and < 3.0
6 Star	< 2.5

WELS ratings explained

WELS ratings have been developed for tapware, toilets, showers and urinals. The ratings are taken from AS/NZS 6400:2005.

Table 11 – WELS rating specifications for showers

Rating	Specification (L/min)
0 Star	> 16
1 Star	> 12 and < 16
2 Star	> 9.0 and < 12
3 Star	> 7.5 and < 9.0 [a]
4 Star	> 6.0 and < 7.5 [a]
5 Star	> 4.5 and < 6.0 [a]
6 Star	> 4.5 and < 6.0 and fitted with bonus features (e.g. automatic shut-off) [a]

[a] subject to finalisation of industry force of spray test.

Table 12 – WELS Rating specifications for urinals

Rating	Specification (L/single stall or L/600 mm of continuous length)
0 Star	> 2.5 serving a single stall or 4.0 for two stalls
1 Star	< 4.0 serving two stalls or equivalent continuous width [a]
2 Star	< 2.5 serving two stalls or equivalent continuous width [a]
3 Star	< 2.0 serving two stalls or equivalent continuous width [a]
4 Star	< 1.5 serving two stalls or equivalent continuous width [a]
5 Star	< 1.0 serving two stalls or equivalent continuous width [a]
6 Star	< 1.0 serving two stalls or equivalent continuous width [b]

[a] must be fitted with demand-driven or smart-demand operation.
[b] must be fitted with demand-driven or smart-demand operation with a urine sensing device.

Chapter 14

Saving water in cooling systems

Most commercial buildings in Sydney have cooling towers installed. Cooling towers are generally the second largest users of water in commercial buildings. If there are no leaks, they account for 20–33 per cent of water used in commercial buildings.

The Sydney Water guidelines *Best practice guidelines for cooling towers* provides information on reducing water use in cooling towers. You can get a copy of these guidelines from the EDC Business Team, or download them from www.sydneywater.com.au.

Key ways to cut cooling tower water consumption are:

- monitor water consumption, fix all leaks and minimise drift/splash and bleed losses
- identify alternative water supplies for cooling towers and alternative cooling methods
- minimise heat loads on the cooling tower by improving energy efficiency in your building.

Cooling towers in commercial buildings

Here are some useful figures on cooling towers:

- There are 6,500 cooling towers registered in New South Wales and 5,000 of these are in Sydney, the Blue Mountains and Illawarra.
- In air conditioned commercial buildings, cooling towers account for 20–33 per cent of total water use.
- Evaporation accounts for about 88 per cent of water use in a well operated cooling tower.
- About 1.0–1.5 per cent of water recirculated within the cooling tower is evaporated.
- Bleed accounts for five per cent of a cooling tower's water use.
- Splash and drift loss accounts for seven per cent of a cooling tower's water use.
- Current regulations limit drift loss to 0.002 per cent of recirculating water in a cooling tower.

- For every 1,000 kilowatts of cooling load, 750 litres of water is condensed.
- Overflow in some poorly maintained cooling towers can be as high as 40 per cent of water use.
- Increasing bleed cycles from three to nine reduces the volume of water sent to sewer by 75 per cent and the volume of water used to makeup the cooling tower by 25 per cent.
- Every 1 °C increase in the temperature of condenser water decreases the efficiency of the chiller by 3.5 °C.
- Cooling towers reduce the temperature of condenser water by 5–15 °C but cannot reduce the temperature to less than the wet bulb temperature of the outside air. In Sydney the average yearly wet bulb temperature is 14.9 °C (this fluctuates with the seasons).
- Summer peak water use in cooling towers is often twice the average annual daily load.

Reducing water use in cooling towers

There are several ways to reduce water use in cooling towers:

- Use the checklist at the end of these guidelines.
- Install pulse emitting sub meters – and read or monitor them – so you know how much water your cooling tower is using.
- Keep your feed pipes low to prevent excessive water loss during shutdown.
- Ensure water balance floats are maintained in cooling tower basins.
- Monitor and maintain your system as leaks can occur from pipe joints and pump glands.
- Replace packed pump gland seals with mechanical seals.
- Install drift eliminators.
- Reduce water loss by increasing cycles of concentration. Sydney's drinking water supply has relatively low levels of dissolved solids, meaning you can cycle up the amount of solids by nine times by evaporating water through the cooling tower without affecting cooling tower performance.
- Reduce water loss by cleaning conductivity sensors monthly and recalibrating them every six months.
- Reduce water loss by using automatic bleed lockout.
- Install a tower bypass so that the cooling tower does not get filled during low temperatures, when the need for cooling is low.
- Manage your cooling tower maintenance contractor on a performance based contract that includes specific water efficiency KPIs.
- Ensure preventative maintenance is conducted monthly.

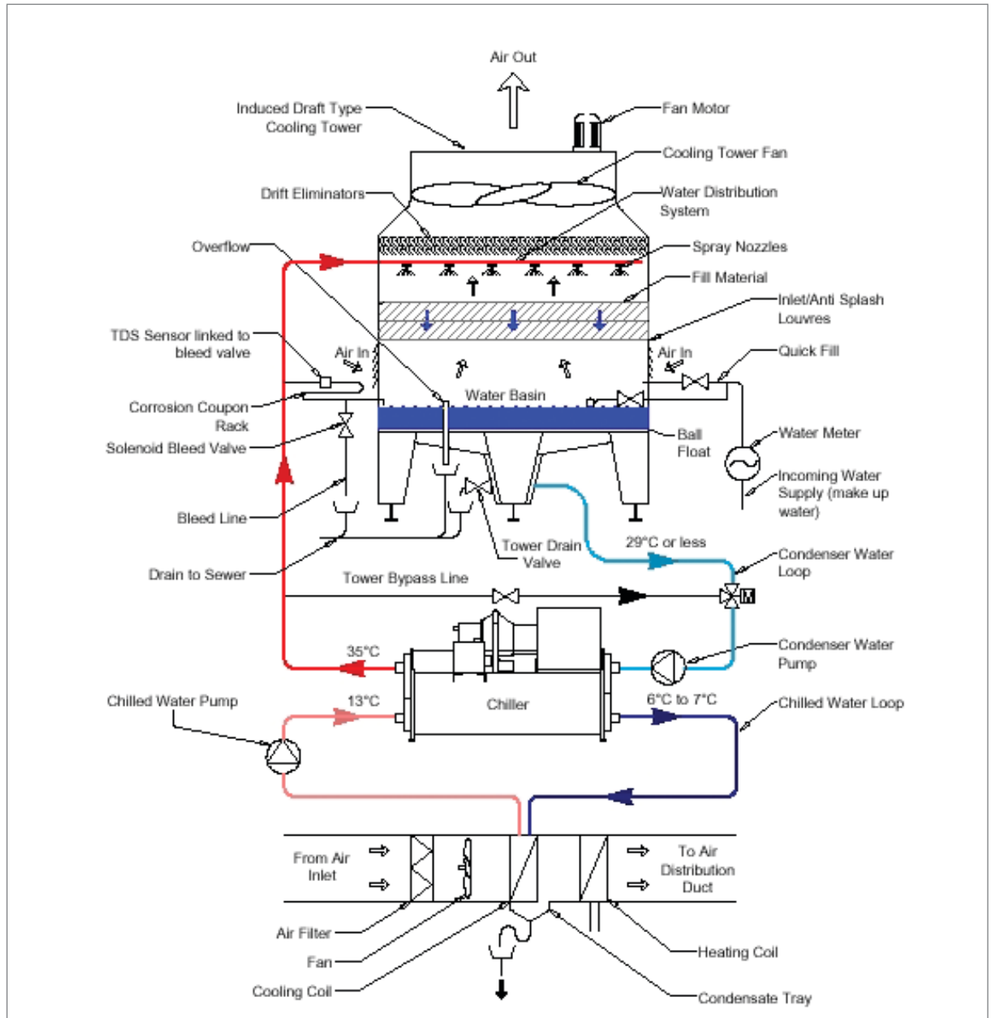


Figure 15 – Key features of a typical cooling tower.

Using alternative water sources

There are opportunities for using alternative water sources in cooling towers.

Condensate is created by building cooling systems when warm humid air is cooled and dried. As condensate can be very clean with very low levels of contaminants mineral or bacteriological, it can be effectively used in cooling towers. Condensate is generally drained to sewer but opportunities exist to capture it and reuse it in cooling systems. Condensate may also be used for toilet flushing and irrigation.

Studies undertaken by Sydney Water indicate that a large shopping centre might be able to capture between 672 kilolitres and 1.2 megalitres of condensate a year and an office building might be able to capture between 900 kilolitres and 3.7 megalitres.

The costs of setting up a condensate reuse system will depend on the existing plumbing design in your building. Buildings with separate flusherette systems may have cost effective opportunities. Storage tanks, the amount of space available, the set point of economy cycle in your HVAC system and location of existing plant all affect the feasibility of recovering condensate.

Rainwater, captured and treated stormwater, treated bore water, and treated wastewater can all be used in cooling towers.

More information on these water sources is detailed in Part 2 of these guidelines. It is a good idea to discuss your plans to use alternative water sources with your cooling tower manufacturer and service contractor and to ensure the quality of alternative water sources is adequate for your needs.

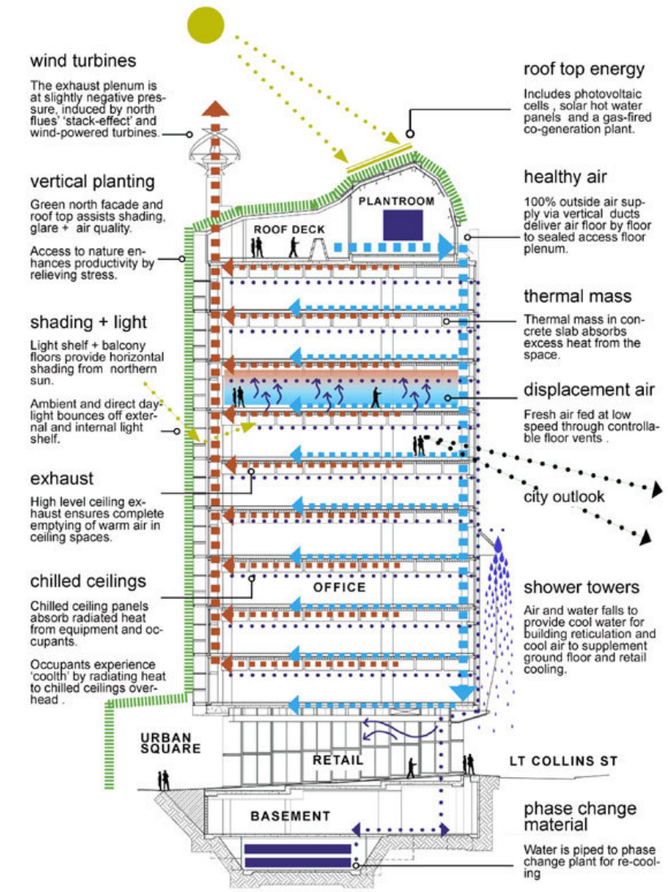
Alternatives to cooling towers

Cooling towers are popular choices for commercial buildings because they are reliable, they have a relatively small footprint, the technology is well understood and, if well maintained, they are relatively cost effective to operate.

There are other ways of providing cooling services to commercial buildings that may use less water or energy than cooling towers.

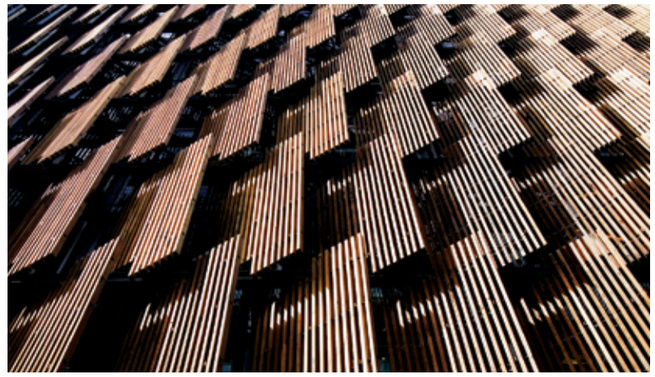
Alternative cooling may have lower cooling loads than traditional air conditioning systems, meaning greater use has to be made of design features to reduce indoor and outside heat gain and improve a building's thermal mass. Melbourne's CH2 building has incorporated a range of passive solar and alternative cooling techniques.

As well as cooling towers, it has a radiant cooling system using the thermal mass of vaulted concrete ceilings with chilled ceiling panels and beams, thermal storage batteries of Phase Change Material (PCM), evaporative cooling in the form of shower towers and 'night purging' of the building allowing cooler night air to remove the heat from ceilings' concrete surface.



Bio climatic section

Figure 16 – Key features of the cooling and ventilation system in the CH2 building, 218–245 Little Collins Street Melbourne.



Air cooled chillers

Air cooled chillers do not use cooling towers. They eliminate the condenser water loop and have very low water consumption, low maintenance costs, little need for chemical treatment and no legionella risk.

Air cooled systems rely on temperature difference to transfer heat from the air conditioning system to the atmosphere. Air cooled systems are more cost effective for plants operating at less than 450 kilowatts of refrigeration but they do have disadvantages:

- they don't reject heat as efficiently as cooling towers because most HVAC peak loads occur when ambient temperatures are high
- in order to reject heat, air cooled systems require large airflow rates or large surface areas
- they can be noisy.

Hybrid cooling systems

Hybrid cooling systems use a combination of conventional water cooled and air cooled systems. Water to be cooled is passed through the dry air cooled section then through the wet section of the cooling tower.

During cooler times of the year, only the dry cooling tower section is used, reducing water consumption. The advantages of hybrid cooling systems are both technical and economical.

Capital costs for hybrid cooling systems can be two to three times higher than a conventional cooling tower, however, water use can be 68 per cent less than conventional cooling towers and the risks of legionella outbreaks are minimised.

Ground source geothermal systems

In geothermal systems, cooling water is passed through a series of long loops (bores) buried deep in the ground. Unwanted heat is passed to the soil and rocks, where it is dissipated. Since this is a closed loop system, there is little or no water usage.

Geothermal systems have been installed at Macquarie University and at the NSW Department of Environment and Climate Change at Lidcombe. Geothermal systems can cost up to 40 per cent more to install than conventional water cooled systems, but they can be very cost effective to operate. They also have low maintenance costs and little legionella risk.

It can be difficult to install these systems in built up areas because of the amount of land required for bores.

Water source geothermal systems

Water source geothermal systems make use of underground aquifers. Direct use systems draw water up from the ground, pass it through a heat exchanger and return it to its source. Indirect systems use closed pipework loops that pass through the aquifer. The costs of indirect systems can be comparable to a conventional water cooled system.

Phase change materials cooling systems

Phase change materials (PCMs) can be used in commercial building cooling systems. PCM systems take advantage of the energy storage properties of different materials.

In passive phase change designs, PCMs can be encapsulated in building materials such as concrete, gypsum wallboard, in the ceiling or floor to increase their thermal storage capacity. They can increase the comfort of occupants by reducing the magnitude of temperature swings. (Bruno, 2004)

PCMs can be used in active cooling systems. Some, such as ice, are solid when temperatures are cool and become liquid when they absorb heat. In such systems, ice or chilled water is made overnight when temperatures are generally low and electricity is cheaper. During the day, heat is dissipated into the ice or chilled water. Ice storage systems take up less space than chilled water systems. It is important to design and locate ice storage systems well. A trial ice storage system installed by Integral Energy was successful in reducing peak energy demand, but used more energy than the standard operation of the building's cooling system, possibly because the ice storage system was located in direct sunlight. (Bruno, 2007)

PCM systems can be used in conjunction with more traditional heating and cooling systems so it is no longer necessary to install very large chillers to deal specifically with peak loads that occur on only a few hot summer days. This saves costs of water and electricity.

Other phase change materials used in commercial building cooling systems include organic materials such as paraffin waxes and inorganic materials such as such as salt hydrates.

Chilled beam technology

Chilled beams use tubes of cooled air in the ceiling to cool warm air, which will rise to the ceiling. The cooled air will descend into the space. Maintenance and energy consumption is low for these systems as they incorporate a one pass air supply system.

Chilled beam technology is becoming more common in Australian buildings. It has been used in 30 The Bond building in Sydney and has been specified for the new Sydney Water office in Parramatta.

Water in the system recirculates, meaning there is no ongoing water consumption.

Reduce heat loads

You can reduce the amount of water used in cooling towers by reducing the heat loads in your commercial building.

It is estimated that up to one third of cooling load in a commercial building is due to heat from lighting and another third to solar heat gain through windows. (Franconi and Huang 1996, cited in Lee et al, 2002)

Shopping centers and commercial buildings can reduce the load on cooling towers by:

- reducing heat generated by electrical equipment
- reducing heat generated by lights
- using building design to use daylight and avoiding outside heat.

Buildings that are designed and operated to reduce heat loads allow owners to use smaller air conditioning and ventilation plants. Reducing the size of HVAC systems can lead to significant savings in construction and operation.

Reduce heat generated by electrical equipment

Possible opportunities for reducing heat load produced by electrical equipment in your building include:

- enable energy star is enabled on computers, copiers, faxes and other office equipment
- replace any remaining CRT monitors with LCD computer screens
- purchase suitably sized office equipment as small devices use less energy and create less heat
- reduce printer use by setting double siding and black and white as default
- encourage on-screen viewing of documents and digital filing
- encourage staff to turn computers off every evening.

Reduce heat generated by lights

Possible opportunities for reducing heat load produced by lights in your building include:

- replace existing fluorescent tubes with T5 fluorescent lights
- use light reflectors to improve light efficiency
- install movement sensors to turn lights off when the building is unoccupied
- install photo sensors to reduce lighting levels when daylight is good
- replace incandescent globes with compact fluorescent globes
- divide the lights in each office space into multiple zones and install separate light switches for each zone
- replace low voltage halogens with 35 watt Infrared coated (IRC) lamps, compact fluorescent globes or LEDs
- use High Intensity Discharge lights or metal halide lights for large area lighting
- use principles of passive solar design and daylighting to make use of natural light without heat gain from outside.

Table 13 – Low heat load producing alternatives to conventional lighting.

Inefficient lighting	Replacement lighting	Advantages and Disadvantages
Standard fluorescent tubes	T5 fluorescent lights, electronic ballasts and lux reflectors	**Advantages** - lower energy use - slim line - less flicker and buzz - low levels of mercury - white light - long life - low loss of light over lifecycle - high output lights available if needed **Disadvantages** - will require new fittings and ballasts
Incandescent globes	Compact fluorescent globes	**Advantages** - lower energy use - available in wide range of colours and sizes - long life - will fit existing light sockets and fittings - dimmable versions now available
Low voltage halogen lights	Compact fluorescent globes designed for recessed and track lighting	**Advantages** - lower energy use - cheaper globes **Disadvantages** - requires new fittings - light output not as strong, may need more globes
Low voltage halogen lights	35 W Infrared coated (IRC) lamps	**Advantages** - lower energy use
Low voltage halogen lights	LED lamps	**Advantages** - lower energy use - longer life globes **Disadvantages** - relatively new products, availability limited - more expensive globes

Use daylight and avoid outside heat

Buildings that can maximise the use of daylight and avoid outside heat can be designed with less heating, improved ventilation and more effective air conditioning systems. This can significantly reduce the cost of fitting out and operating a building.

To achieve these outcomes, design features should include:

- light shelves and high windows
- low heat transmitting glass and changeable window surfaces
- window shades, eaves and automatically adjustable external louvres
- lower office partitions to allow daylight to penetrate further into the building
- light coloured and semi reflective surfaces
- keeping a low roof surface area to building volume
- high thermal mass internal and external walls, double window and wall skins and effective ceiling, wall and floor insulation
- light coloured roofing products to reflect heat
- vegetated roofs to add thermal mass to the building and moderate temperature swings.

These design features can improve building aesthetics and the comfort of its occupants.

Case study
30 The Bond

30 The Bond at Hickson Rd in Sydney is on a predominantly west facing site which means it faces the hot afternoon sun. In a traditional office building this would increase heat gain in the afternoon resulting in higher water and energy use for cooling.

To reduce heat gain from outside, the building incorporates external, automatically adjustable louvres. These are similar to an external venetian blind that will move during the day as the sun moves west. Building occupants can over-ride the automatic louvres and control the tilt of their blinds to suit themselves.

The appearance of the louvres has become part of the architectural appearance of the building. (Bovis Lend Lease, 2003)

Photograph 6 – Adjustable louvres on 30 The Bond, Hickson Road Sydney, reduce the effect of the hot afternoon sun on the building's internal temperature. (Photo courtesy of Gollings Photography).

Keeping shopping centres cool and water efficient

The challenge to reduce heat gain in shopping centres is due, in part, to the number of heat-generating activities such as cooking in food courts, retail displays of electrical products, large numbers of people walking in and out of air conditioned spaces, and the use of large common areas.

The following design features can help reduce heat gain from outside the building:

- verandah shading over shopfronts, combined with low conductivity shopfront glass can improve the comfort of shoppers by reducing glare and direct heat
- reducing the number of large windows that face west will reduce heat gain
- using wall materials of a high thermal mass, such as 'thermo-mass' insulated concrete panels will reduce heat gain. A 200 millimetres thick concrete wall in a shopping centre building envelope can delay peak envelope heat load by eight to 12 hours. This enables most cooling to be done in the evening and night when the outside air is already cooler.

It also improves opportunities to cool the centre by ventilating with outside air

- using a store or shopping centre entry airlock will reduce the loss of air conditioned air. (ITR, 2004) Zoning supermarkets and shopping centres into areas with different heating and cooling requirement and setting up air curtains can provide energy savings of at least 10 per cent. Physical barriers are even more effective. (ITR, 2004)
- reducing the height of shopping centre ceilings will reduce the air volume that needs to be heated and cooled.

Equipment used in shopping centres that can increase heat load include:

- bakery ovens
- commercial kitchens (in restaurants and supermarkets)
- hot water heating
- product display lighting and shop signage
- electrical equipment used for retail display – computers, plasma screen TVs and heaters
- food refrigerators.

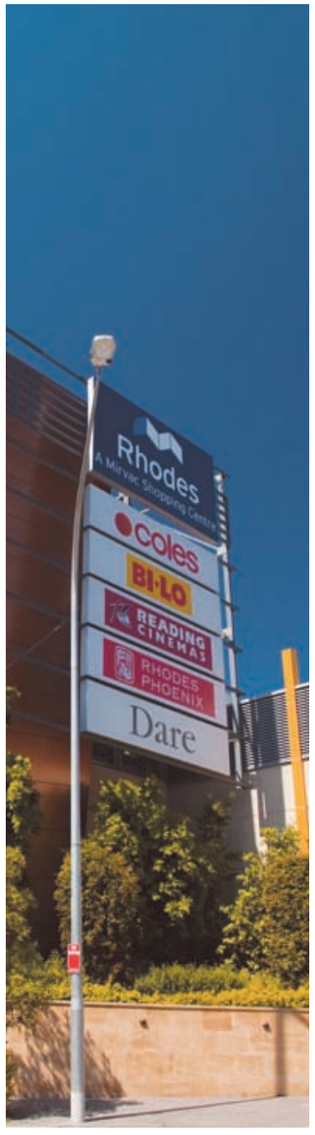


Table 14 – Common sources of heat found in shopping centres and suggested solutions to reduce heat load (Department of Industry, Tourism and Resources 2003–04).

Heat Source	Solution
Outside sun and glare	- verandah shading - low conductivity glass - high thermal mass walls - shopping centre entry air lock - shade windows - reduce number and size of west facing windows - replace barrel vault skylights with shaded skylights or clerestory windows
Kitchens and food preparation areas	- use ovens with fully insulated solid doors, walls, oven decks and drive shaft - use ovens with fully sealed doors (replace worn seals regularly) - install back draft dampers to stop loss of cooled air when ventilation fans are not in use - use waterless woks that vent cooking heat - use ovens and stoves with programmable temperature and time controls
Motors of refrigerators and freezers	- use refrigerator cabinets with doors to reduce compressor size by up to 30 per cent
Hot water heating	- use instantaneous hot water systems so that water is only heated as needed
Electrical equipment turned on for retail display	- make sure retailers turn equipment off at the end of each day's trading - encourage retailers to set up more attractive product displays with only a few items turned on - sub meter energy and water use so that tenants know how much they are using
Staff and tenant practices	- make sure staff know how to use ovens, air conditioning systems and zoned lighting - monitor and publicise energy and water use so that staff know how much they are using.

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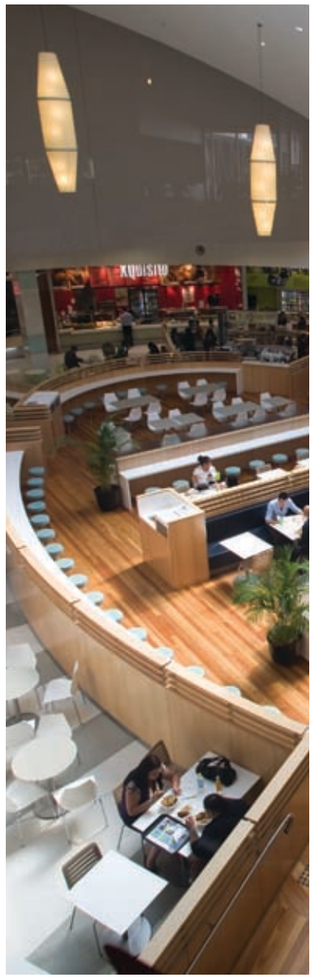

Chapter 15

Saving water in food courts and kitchens

Food courts and restaurants can be water intensive. Almost all shopping centres and many large commercial office buildings contain a food court.

Each cafe, coffee shop and restaurant uses an average of 3.4 megalitres of water a year. Fast food shops use an average of 2.7 megalitres of water a year.

Case study
Mandarin Centre – sub metering of tenancies

The Mandarin Shopping Centre contains a shopping centre, restaurants and a licensed club. Centre Management undertook a water efficiency audit after joining the EDC Business Program in May 2006.

The audit revealed that restaurants were the greatest water users in the Mandarin Centre, with one restaurant using nearly a third of the Centre's entire water consumption.

After seeing the results of the water audit, Centre Management installed a customised monitoring system to allow online monitoring of the sub meters. This allowed Centre Management to monitor the water consumption of each tenant and charge for water use. Tenants now have a direct incentive to conserve water and take ownership of their water consumption.

Kitchens

Main areas of water use in kitchens include:

- dishwashers and glass washers
- basins and sinks, especially if running water is used for thawing
- pre rinse spray valves used for removing food scraps and grease before washing
- icemakers
- water cooled wok stoves and yum cha / rice steamers
- food preparation practices, including thawing, food blanching and pasta cooling
- cleaning.

Even in busy restaurants it is important to report leaks and undertake regular maintenance. A leaking hose in one restaurant audited by Sydney Water wasted one thousand litres a day.

Commercial dishwashers

Dishwashers, glasswashers and underbench washers are used in many restaurants. The following basic changes to staff procedures can make dishwashers run more efficiently and save money in water, wastewater and chemical costs:

- ensure dishwashers are fully loaded before use. If racks do not suit the type of dishes you are washing and you cannot load them efficiently, talk to your supplier and see if you can get different rack configurations
- scrape food scraps from plates and cooking equipment into the bin before loading them into the dishwasher
- replace worn or missing nozzles. One missing nozzle can double water use in a dishwasher
- adhere to the manufacturer's recommended equipment flow rate
- install flow control to the rinse line, where applicable
- where using a rack conveyor dishwashers, fit an auto timer or electronic sensor to prevent rinse water running when dishes are not passing through the system
- replace scrapping trough systems with a conveyor system that does not require water to carry waste from the base of the dishwasher to the disposal unit.

New dishwashers can cut your running costs by nearly one third by reducing demand for water, hot water and detergent. Recent studies have shown that the environmental benefits of replacing inefficient dishwashers are so great that they outweigh any environmental costs involved in the production of new models. The more you use your dishwasher, the greater the cost and environmental benefits of using a new model.

Pre rinse spray valves

Pre rinse spray valves (PRSVs) remove food scraps and grease from dishes before they go into the dishwasher. This improves the cleanliness of dishes and reduces water and chemical consumption because dishwasher tank water can be used for more cycles.

These devices use a surprisingly large amount of water. A Sydney Water study indicated that every year 4.6 gigalitres of water per year is used by PRSVs in restaurants and 1.3 gigalitres of water is used by PRSVs in take away food shops.

Flow rates in traditional PRSVs are typically 10–15 litres per minute and are fitted with a shower type spray head that relies on water volume for its cleaning action.

More efficient PRSVs are now available. They have a single orifice nozzle that produces a powerful fan-pattern jet that uses water velocity, rather than volume, to increase cleaning efficiency. New models have a 6–7 litres per minute flow rate at normal water pressure and use 50 per cent less water than older models.

A Sydney Water study showed that small and medium sized hospitality business can make significant water and energy savings by using Low Flow PRSVs (LFPRSVs). Table 15 shows how much water and money was saved at four sites retrofitted with LFPRSVs. Hot and cold water use at each site was monitored for four weeks.

PRSVs generally deliver water at between 40–60°C which means reducing water use can also cut energy costs.

Australian legislation now requires PRSVs to have a WaterMark™ to show that it complies with plumbing and manufacturing standards and a Water Efficiency Labelling Scheme (WELS) rating.

A 6 star rated LFPRSV design uses 6 litres per minute.

Manual pre wash units are the most water efficient form of pre wash system. Where automatic pre washers are required, consider installing low flow, high pressure spray heads or a flow reduction valve.

Spray valves need to be inspected regularly and replaced if the fittings are worn. Worn nozzles will have reduced pressure and reduced spray angle, leading to water wastage. It's also important to check with your supplier to make sure that you are using the right design of spray rinse valve for your application.

Low Flow Pre Rinse Spray Valve (LFPRSV) program (Smart Rinse)

Sydney Water is starting a program, named Smart Rinse, to encourage small and medium businesses to install LFPRSVs. Sydney Water will supply and install a 6 litres per minute LFPRSV at no cost to the customer. The valve is WELS 6 star rated and will not lock on at full pressure.

The Smart Rinse program will run for three years from late 2007.

Ice making machines

Using an air cooled ice machine is the most efficient way to make ice in a restaurant or cafe. An air cooled machine will use about 1.9 litres of water to make a kilogram of ice which is seven times less than a water cooled machine.

If your machine is making too much ice it will also waste water. Adjust it so it only dispenses the amount of ice you need.

Asian style restaurants

Asian style restaurants that use water intensive woks and steamers will be big water users. In these businesses, water cooled woks can account for up to three quarters of all water used.

Sydney Water has developed the concept for a waterless wok that has been adopted by several stove manufacturers. Waterless woks can save a busy kitchen up to 5 kilolitres of water every day, as they use air cooling instead of water cooling.

The Ethnic Communities Council (ECC) of NSW is rolling out waterless woks to restaurants and providing grants to help cover the costs of replacing old woks. Contact the ECC at wok@eccnsw.org.au

Table 15 – Typical water and cost savings achieved by various types of business following the installation of a low flow pre rinse spray valve

Site	Water consumption savings (L/day)	Water savings (% of original consumption)	Water and Energy Cost Saving (a year)
Cafe	449	46.5	$453
Restaurant	232.9	42.3	$304
Club	100	28.7	$143
Hotel	695	50	$925

Steamers use water for equipment cooling and food process cooking. Efficient steamers can use up to 90 per cent less water and up to 60 per cent less energy than older models and have shorter cook times, higher production rates and reduced heat losses.

Food thawing

Some kitchen staff use running water to thaw frozen food. This can use 6 kilolitres of water every day and allow the growth of food poisoning organisms. It is therefore important to thaw food properly. Two acceptable ways of thawing food are:

- place frozen food in a refrigerator the night before using it. This will allow the food to thaw while remaining cool, retain good texture and remain free of contamination from bacteria and toxins.
- use a microwave oven. Only use this method of thawing food if you intend to cook meat immediately, as the microwave can start the cooking process.

Food Safety Standards in New South Wales require kitchens to minimise the amount of time foods such as meat are kept at 5–60°C. Defrosting food under running water is likely to put food into this temperature danger zone.

Other water saving tips for kitchens

Other ways to save water in kitchens include:

- do not use in-sink garbage disposal units
- use a sink strainer or dry waste arrestor to trap food scraps before disposal
- consider using wastewater from dishwashers for use in garbage disposal units where water quality is not important
- sweep or mop the floor instead of hosing it down with water because unless you have an exemption, water restrictions in Sydney prohibit hosing down of hard surfaces
- if you have an exemption for hosing down kitchens or floors, you must still use a trigger nozzle on your hose.

Photograph 7 – The waterless wok was developed by Sydney Water.

Chapter 16

Saving water in gardens and landscaping

The amount of water you need to use in gardens and landscaped areas will depend on:

- **the size of the area you irrigate**
- **the water holding capacity of the soil**
- **the rate at which water is lost through evaporation, soil infiltration and plant transpiration.**

Regardless of the size or style of your landscaped area, or the source of water you use, these general principles will help you save water outside.

Improve your soil

Your soil type, structure and texture has a big influence on how much water landscaped areas will retain, how rapidly they can absorb irrigation or rainwater and how your landscaped areas will cope with drought.

The quality of soil near building sites and its water holding capacity will be poor if topsoil was disturbed or removed during construction or if building wastes were spilled into landscaped areas.

The most reliable and cost effective means of improving soil is by mixing organic matter such as composted cow manure into the top 300 millimetres of the soil. Organic matter improves soil's water holding properties, adds important nutrients and improves plant health.

In sandy soils, the manures help bind the sand particles together, improving the soil's ability to store water. In clay soils the very fine clay particles become more separated when manures are added which allows water to infiltrate more quickly.

Mulching around plants helps to retain water in the soil. Good mulch will reduce evaporation from the soil surface by up to 70 per cent, stablise soil temperatures and add organic matter to your soil. Mulch can also inhibit some weed growth although you should ensure mulch is free of weed seeds. Spread mulch 7 centimetres deep to insulate roots from heat as well as weed growth. Avoid fine textured mulches because

they tend to remain wet for longer and weeds can become established within the mulch.

Plant selection and maintenance

The type of plants you select will affect how much you need to water. Consider the following when designing landscaped areas for your building:

- Sydney Water has a plant selector at http://www.sydneywater.com.au/SavingWater/PlantSelector/ that can help you select the best plants for your area and your soil type
- group plants with similar water needs together
- think about the conditions in which plants will be living. Do not use plants native to rainforests or creeks if you want them to grow next to surfaces that reflect heat and light, receive full sun, or next to vents that expel hot air
- extra time spent selecting plants for your landscaping will be repaid in better survival and growth rates, and a more attractive site for people to visit
- you can save water in grassed areas too. Ensure the topsoil is more than 15 centimetres deep so that deep rooted turf species, eg kikuyu, couch and buffalo can draw on deeper water reserves during droughts. Most buffalo grasses (such as Palmetto) are slow growing and do not need mowing as often as other lawn types
- don't mow your lawn too short. Leave grass at least two centimetres high so that the grass shades the soil and less water evaporates. Maintain this length by cutting only the top third of the leaf area. In dry conditions, leave the clippings on the lawn to keep moisture in the ground and to cycle nutrients back to the soil.

Efficient watering

The most efficient way to water landscaped areas is to water when the soil has dried and to water for long enough to ensure the soil profile is full to capacity.

Professionally installed irrigation systems that have soil moisture sensors ensure an even distribution of irrigation water that is applied at a rate that matches the soil's absorption rate and for a duration that ensures the soil's profile is filled to capacity.

Irrigation frequency is related to the climate and the plant's rate of water transpiration, which are related. Irrigation frequency changes with the seasons and with local weather variables, such as temperature, humidity, wind and hours of sunlight.

Water the base of plants, not the leaves. This provides water directly to the roots where it is needed the most and reduces evaporation and leaf burn. You can also save water by watering your garden early in the morning or late in the evening.

If you use drinking water supplies, Sydney Water restrictions do not allow sprinklers to be used on any landscaped areas except active sports fields.

Automatic systems are convenient because you cannot forget to turn them off. If you do use an automatic system, make sure it has rain and/or soil moisture sensors so that water is only applied when needed. All systems must be inspected regularly to make sure that sprinkler heads and timers are working properly and not wasting water.

Water restrictions affect how and when you can use water outdoors.

For the latest information about water restrictions in Sydney visit www.sydneywater.com.au.

Alternative water sources

Water use benchmarks for commercial buildings have not been adjusted for the amount of irrigated area a commercial building has, because it is possible to use non drinking water supplies to maintain these areas.

Alternative sources of irrigation water include rainwater tanks, treated and reused greywater, water from fountains (that wouldn't otherwise be recirculated), or captured stormwater. These water sources are discussed in Chapters 20–23 of these guidelines.

If you plan to use greywater or stormwater to irrigate, it's important that you understand the properties of your soil and what contaminants might be in your alternative water source. This will help you manage your water recycling project so that soils do not become overloaded with pollutants that will eventually affect plant growth, soil structure and the surrounding environment.

Photograph 8 – The gardens at Rouse Hill Town Centre, owned and managed by The GPT Group, were designed and constructed with water efficiency as a high priority. The site aims to use 60 per cent less water than a typical, equivalent sized shopping centre.

Case study
CH2 green facades

Green facades and roof gardens can reduce a building's cooling load and reduce the urban heat sink effect. CH2 Building in Melbourne has incorporated these principles with water efficient gardening techniques.

The CH2 building includes a roof garden and a planted northern facade, as well as internal plantings and plantings in terraces on the west end of the building.

CH2 uses a watering system and water saving flakes that provide water as demanded by the plants. When the flakes dry out, the watering system is triggered to operate. The system is designed to optimise plant health, while minimising water wastage. The system also helps to achieve the design objectives of ensuring that the building site has as many leaves as it would in its naturally vegetated state. (Othman and Jayasuriya, 2004).

Photograph 9 – A roof garden on the CH2 building at 218–245 Little Collins Street Melbourne

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Chapter 17

Saving water in water features

Fountains can be a useful landscaping element. If small fountains are well designed and maintained, their water use will be low. Large or leaking water features can use up to 30 kilolitres of water a day.

Leaks, excessive splash, evaporation and wind drift will increase the water consumption of a fountain. Good design, monitoring and maintenance are all essential to make sure that your water features are not water wasters.

Key considerations for maximising water efficiency in your water features include:

- supply lines to the water features should be individually sub metered. These meters should be regularly read and recorded to identify leakage and excessive usage
- all new water features should have sub meters installed during construction
- instruct your water treatment contractor to report on any apparent water wastage, or leaks from fountains in their monthly reports. Sub metering fountains will help you discover hard to detect underground leaks
- use biocides to prevent microbial growth in the water. This will lengthen the time between cleaning. However, ensure chemicals will not cause corrosion of the water feature piping. Bromine is often used to prevent microbial growth in water features because it has lower odour than chlorine. If bromine is used, PVC piping should be used because bromine will corrode brass and copper
- fountains that produce high, fine droplets of water will be prone to wind drift. If water features are prone to wind drift, install a wind sensor so that water features are automatically turned off in high winds. Check the operation of your wind sensor regularly to make sure that it works properly
- do not install fountains that are likely to create drift in areas with strong prevailing winds as they will waste water and cause inconvenience for passing pedestrians. Wind drift can be minimised by installing fountains behind wind breaks such as screening trees

Photograph 10 – The iconic Archibald fountain in Sydney's Hyde Park, a facility managed by City of Sydney Council.

- outdoor water features with shallow pools of water over large areas of dark stone can also be prone to evaporation. Installing them in shaded areas will significantly reduce water use

- if you are undertaking a new landscaping project, think about other landscaping opportunities that don't require as much water and maintenance as fountains. Consider using some of the sculptural elements of the fountain that do not require water

- rainwater and stormwater can be used to create landscape features without using drinking water supplies. Rainwater gardens use excess stormwater runoff as a non-permanent landscaping element. Plants and elements such as rocks or sculptures are placed near downpipe exits or in swales along the course of a stormwater drain. Even if water isn't a permanent feature, changes to the aspect and microclimate created by rainwater gardens may allow for variety in your site's landscapes.

Rainwater gardens can also be an important element in your site's stormwater management. It will improve the quality and reduce the quantity of stormwater discharged from site.

Chapter 18

Saving water from fire service tests

Property owners are legally required to test fire sprinkler booster pumps regularly to make sure that they will work properly during a real fire. During tests, the pumps operate as they would during a real fire, except that water is diverted from the sprinklers instead of being sprayed into the building.

Many property owners test every week. A single test can use up to 60,000 litres of water. In older buildings, the water is pumped directly to stormwater or sewer. This means that every year some buildings can pour over three million litres of water straight down the drain.

Water used for fire services is not yet metered in Sydney and this use can be overlooked when property owners are thinking about water efficiency projects.

AMP Capital Investors is capturing fire service test water in holding tanks and reusing it for later tests, saving up to 60 kilolitres of water a week.

In the Citigroup Centre, Jones Lang LaSalle and GPT are reusing fire service test water and saving 33 kilolitres a week. The project had a simple payback period of less than three months.

Other property owners are taking advantage of provisions in the Australian Standards which allow for monthly

Photograph 11 – Plumbing modifications made by AMP Capital Investors at the Dick Smith Electronic Support Office in the western Sydney suburb of Chullora, allow water used during fire service testing to be captured in holding tanks and reused for later tests. This saves up to 60 kilolitres of water per week.

testing of fire sprinklers, if this is backed up by performance engineering solutions.

Investa anticipates that this approach will save 11 million litres of water a year in a portfolio of 16 buildings. Stockland will also be introducing this approach to save water in its portfolio. (DEUS, 2007).

Tenants and cleaners can also inadvertently use fire service water for cleaning and hosing out underground car parks and basements. This is not permitted and property managers should make sure all staff are aware of this.

Figure 17 – Sydney Water has developed stickers to remind tenants and staff that fire hoses should not be used for non-fire fighting purposes.

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Chapter 19

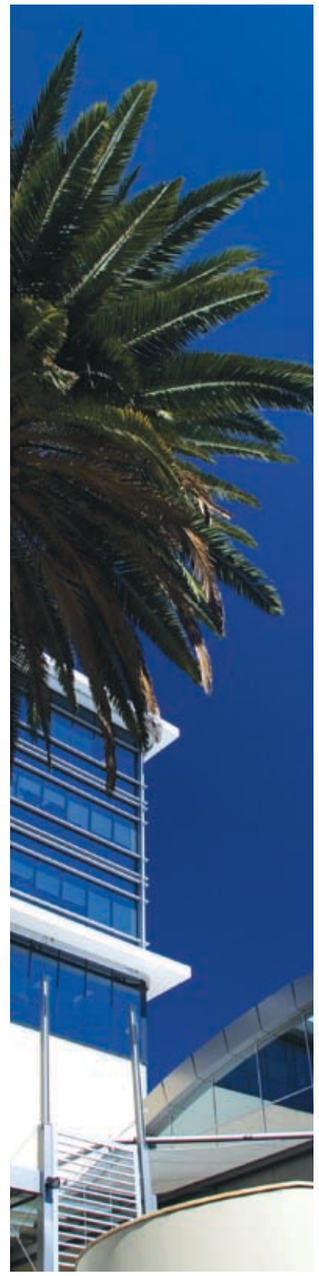
Saving water through pressure management

Reducing the pressure of water supplied in buildings can reduce unnecessarily high flows of water, reduce leaks and improve the life of plumbing fixtures. You can install valves that reduce pressure to reduce water consumption.

Reducing the pressure of water supplied in buildings can reduce unnecessarily high flows of water, reduce leaks and improve the life of plumbing fixtures. You can install valves that reduce pressure to reduce water consumption.

In many high rise buildings, water is pumped to storage tanks located on upper floors so that the water supply can then operate on a gravity system. If the one tank is used to supply all floors, water pressure on lower floors will be excessive.

Zoning water pumping and storage systems can reduce water pressure on lower floors, reduce leaks and wastage and cut pumping and maintenance costs.



Part 3

Alternative water sources

Part 3 of **Best practice guidelines for water conservation in commercial office buildings and shopping centres** provides advice on alternative water sources that may be used in commercial buildings.

Chapter 20

Rainwater

Using rainwater is an excellent way to reduce demand on mains drinking water. Rainwater collected from roofs generally has low levels of pollutants, especially if a first flush diverter is installed. This makes any required treatment relatively simple and inexpensive.

The bigger and cleaner your roof catchment area, the more likely it is that you will be able to implement an effective rainwater reuse scheme.

Using rainwater

Rainwater can be used to replace drinking water for a range of uses including water features, toilet flushing, water heating systems, garden irrigation and outdoor cleaning. Most rainwater has very low levels of dissolved solids that can make it well suited for cooling towers. Make sure you are aware of the properties of rainwater you collect from your site before you use it in cooling towers.

NSW Health does not recommend using rainwater for drinking and cooking when an alternative mains water source is available. Guidelines are available in the document *Rainwater Tanks where a Public Supply is Available* published by NSW Health.

To maximise the amount of water and money you save with a rainwater tank, it's important that you maximise your use of rainwater. This can be achieved by using rainwater where it will be used frequently such as toilet flushing or cooling tower makeup. Frequent use of rainwater also maintains better water quality.

How much rainwater can you catch?

Before implementing any large scale rainwater collection system, you need to be aware of the size of your catchment and the likely annual rainfall you will receive.

Photograph 10 – Rainwater captured in tanks at Investa's 73 Miller Street building in North Sydney, is used to irrigate gardens on the building's rooftop and balconies.

You can refer to the Australian Bureau of Meteorology's website at www.bom.gov.au for data about average annual rainfall and mean days of rain for many locations in Sydney.

You can calculate the theoretical maximum rainfall that can be captured by multiplying your roof catchment area (in metres) by the average annual rainfall in metres.

It is likely that the amount of rainfall you can capture in a given year will be up to 20 per cent less than the theoretical maximum because of losses from evaporation in small rainfall events, infiltration into roof materials, overflows from gutters and tanks during heavy storms and losses to first flush devices.

For a rough calculation of how much water you may be able to save with a tank of a given size, you can use online calculators at https://egrants.com.au/watertankmodel/index.asp

To more accurately model tank sizes, you need to use daily rainfall data, understand your average daily water use and incorporate variables such as temperature and seasonal variability.

Rainwater quality

The quality of rainwater collected will depend on the location in which rainfall occurs, as well as the surface it falls onto and the standard of storage tanks. Rainfall in an industrial area is more likely to collect airborne pollutants and roof catchment areas are more likely to be polluted with settled particulate matter.

Rainwater collected from paved areas including carparks and roads is typically referred to as stormwater and contains significantly higher levels of pollutants. The capture, treatment and reuse of stormwater is covered in Chapter 21 of these guidelines.

The roofs of commercial buildings may collect contaminants like dust, leaves, vegetation, bird faeces and occasionally dead animals. Keeping roofs clean with regular maintenance will improve the quality of collected rainwater, reduce the likelihood that gutters and collection systems get blocked and reduce the amount of treatment that will be required.

A 'first flush device' will also improve rainwater quality. The device sits between the roof downpipe and the rainwater storage tank and will dispose of the first rainfall runoff collected by your roof. Because the first flush contains a higher concentration of pollutants, a properly sized first flush diverter is very effective at improving the quality of collected rainwater.

Use mesh covers and strainers on the inlet and overflow of the tank to prevent mosquitoes and other insects from getting into the tank and breeding. This will improve water quality and prevent your tanks from causing a public health nuisance.

Plumbing requirements and approvals

If your tank is going to require top up from mains water, which is likely if tank water is likely to be used for needs such as toilet flushing or cooling tower operations, you will need to comply with backflow prevention containment requirements and install a backflow prevention device at the property meter to protect the mains supply.

Plumbers must complete all work in accordance with the NSW Code of Practice Plumbing and Drainage and follow the specific technical requirements for rainwater tank plumbing that are detailed in *Guidelines for the Installation of Rainwater Tanks on Residential Properties*, Part 1 Plumbing requirements.

For more information, contact Sydney Water's Plumbing Policy, Standards and Regulation Group at: plumbing@sydneywater.com.au

You should also contact your local council to discuss the regulations that apply to the installation of rainwater tanks, stormwater reuse systems and greywater or black water reuse systems.

In New South Wales, property owners can install tanks of up to 10,000 litres without development approval – providing conditions such as siting, installation of first flush diverters, noise mitigation and mosquito control are covered. Larger tanks or tanks that do not comply with these conditions usually require local council development approval.

Costs and benefits of rainwater tanks

Rainwater harvesting is a popular way to conserve drinking water, although it is usually less cost effective than other measures for reducing water consumption, such as leak reduction and improved efficiency. However, rainwater tanks are easy to install and a strong visual symbol for water conservation.

Rainwater is not governed by water restrictions and can be freely harvested to irrigate parks and gardens. Rainwater harvesting also reduces stormwater discharges from commercial sites, which reduces stormwater flows into the local environment and reduces stormwater volumes during rainfall. It can also be a visible and low risk measure when compared to reuse options.

Equipment and cleaning

Keep your roof catchment clean, install an adequately sized first flush diverter and remove sludge from tanks every two to three years. Your tank water should remain quite clean and you will not need complex treatment systems.

To use tankwater, you usually need to install good quality pumps to ensure adequate operating pressure. You also need a reliable device to switch between rainwater and mains water supply. It is common for poor quality and badly maintained pumps to fail and this can jeopardise the success of your rainwater harvesting operations.

Your plumbing contractor or hydraulic engineer can advise on the costs and installation of this equipment.

You will need to clean your tank regularly to remove accumulated sediments. The technique used will depend on the type of tank you have installed. Advice on how to clean tanks is provided in 'Useful documents' section of this chapter.

Converting onsite detention tanks

Many commercial buildings have been constructed with large on-site detention (OSD) tanks for stormwater. These tanks are designed to capture rainwater and stormwater after heavy rain, and slowly release it to the main council stormwater system so these systems do not become overloaded.

There is increasing interest in converting these tanks to storage tanks. You should consider:

- using your OSD tanks may make design easy because rainwater collection has been centralised, i.e. there is little need to consolidate downpipes that drain different parts of the roof
- OSD tanks will often also take stormwater from paved common areas (like shopping centre forecourts), footpaths, carparks and internal roads. This is likely to increase pollutants including oils and greases in the captured water, which may reduce the uses of this water, or necessitate additional treatment
- it might be necessary to treat stormwater from some areas before it is diverted to your storage tanks. If you have more than one OSD tank, it might be possible to separate your stormwater and rainwater collection so that you can use each water source for purposes appropriate for their different quality.

Useful documents

NSW Health Private Water Supply Guidelines 2007, NSW Health, www.health.nsw.gov.au/public-health/ehb/water/private_supplies.html

Guidance on the Use of Rainwater Tanks 2004, Environmental Health Monograph, enHealth Council, http://enhealth.nphp.gov.au/council/pubs/documents/rainwater_tanks.pdf

Use of Rainwater Tanks Where a Public Water Supply is Available, June 2007, GL2008–09, NSW Health, www.health.nsw.gov.au/policies/gl/2007/GL2007_009.html

Case Study
Lend Lease Retail

Lend Lease Retail operates Macarthur Square Shopping Centre in Campbelltown, in the south west of Sydney. Lend Lease is collecting rainwater from the centre's roof, storing it in a 250 kilolitre underground tank and using it for toilet flushing and garden irrigation.

Photograph 13 – Part of the extensive roof top area at Lend Leases' Macarthur Square in Campbelltown. This roof top is a catchment for 250 kilolitres of rainwater storage.

Case study
Blackmores

Blackmores is one of the leading Australian manufacturers of natural health supplements. It is constructing a new head office building and distribution centre in Warriewood on Sydney's northern beaches. Through development and project managers, Ray White Projects, it is constructing a new building designed by Watermark Architecture & Interiors.

Blackmores is harvesting rainwater for drinking, cooling towers, irrigation and to fill the staff swimming pool. The design of the building was strongly influenced by the company's desire to reduce reliance on mains water as much as possible.

Captured rainwater and stormwater is used to fill water features near the building entrance.

This waterbody reduces ambient air temperature around the building at the point of air intake, further reducing demand on its cooling systems.

Cooling tower blowdown is also captured, treated and reused.

Stormwater overflow is captured by wetlands that have been reconstructed on the site.

The office building can operate independently of mains water for 97 per cent of the year. The manufacturing and distribution centre has higher demand for water because it has a higher cooling load – but the entire site is designed to be independent of mains water for 80 per cent of the year.

Photograph 14 – Blackmores' new head office at Warriewood on Sydney's northern beaches uses a waterbody to pre-cool air before it enters the building's air intakes. The site has been designed by Watermark Architecture & Interiors to operate independently of mains water for 80 per cent of the year.

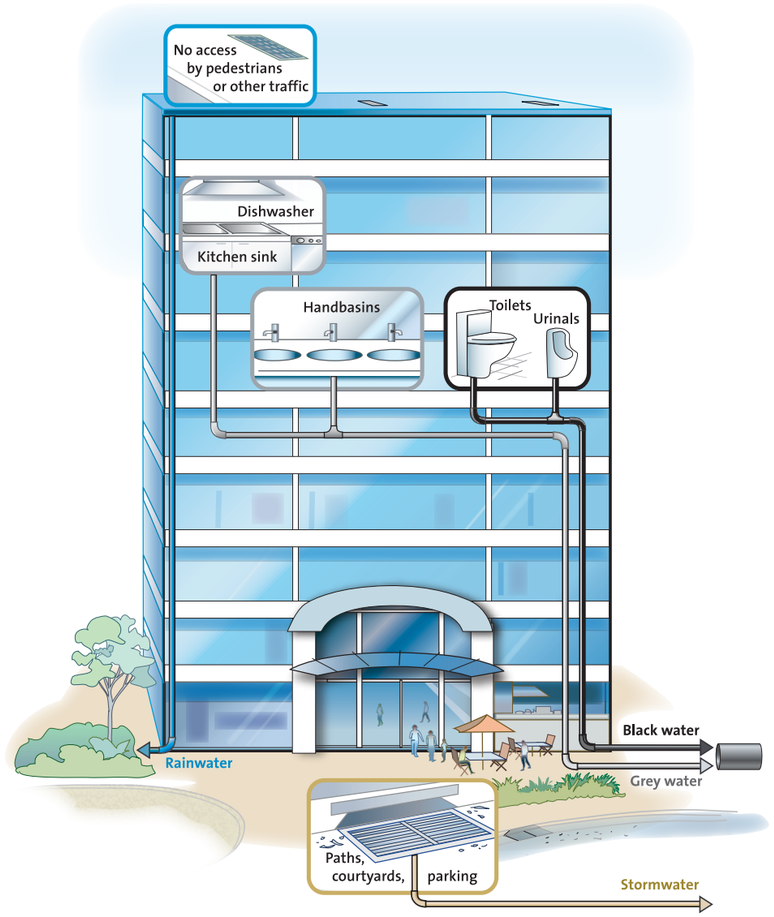


Figure 18 – Rainwater, stormwater, greywater and black water are classified according to the water's source.

Chapter 21

Stormwater reuse

Rainwater that has been collected from outside areas such as paving, footpaths, roads and car parks is generally called stormwater. Harvested stormwater can be used to flush toilets, clean down carparking areas and irrigate garden areas.

As well as reducing your use of mains drinking water, using stormwater will reduce the amount of stormwater discharged from your site and reduce your site's impact on the surrounding environment.

The type of technology used to harvest, store and treat stormwater will depend on specific site conditions including the size of your site, expected local rainfall, the level of likely stormwater pollution, the type of soils on-site and the sensitivity of downstream environments.

Using stormwater

Captured and treated stormwater is often used for irrigation of gardens and parks, water features, vehicle and outside area washing. In some areas where groundwater is extracted, captured stormwater can be used to recharge aquifers.

If you want to use stormwater for uses that have a higher chance of human contact you will need to take more precautions to keep your stormwater catchment clean and treat stored water properly. It is important to understand the quality of your source water and design a treatment and management system that will produce water suitable for your end use.

In some developments, irrigation is used as a method of stormwater treatment because plants and soil will remove nutrients and some suspended solids. Once water is recollected from irrigated areas it can be used for more sensitive uses.

How much stormwater can you capture?

The amount of stormwater that can be captured depends on annual rainfall and catchment size. Precise calculations on how much you can capture will depend on the type of ground surfaces in your stormwater catchments, the aspect and slope of your site and the amount of rain that falls in each rain event.

Campus style buildings and suburban shopping centres have large sites and are more likely to be able to capture and reuse stormwater than high rise commercial buildings on relatively small sites.

Refer to the Department of Environment and Climate Change NSW website at www.environment.nsw.gov.au for information on how much stormwater you can capture and reuse in urban areas in New South Wales under harvestable rights orders.

Stormwater quality

In many commercial buildings, stormwater catchments will be heavily used by people, pets and vehicles.

Stormwater can be contaminated by oils and grease, litter and harmful pathogens. As the quality of stormwater depends on the catchment it is sourced from, it can be easier to reuse stormwater if heavily polluted catchment areas – such as car parks – are excluded.

Keeping catchment areas clean can improve stormwater quality. Installing trash racks or gross pollutant traps can be expensive but will reduce pollutant loads. Regular street sweeping or litter patrols can also remove pollutants. Making sure that operations on your site, such as garbage storage and collection and building and excavation works are well managed, will reduce the chances of harmful stormwater contamination.

Plumbing requirements

If you use stormwater for purposes that may require top up from mains water you need to comply with backflow prevention containment requirements. You should install a backflow prevention device at the property meter to protect the mains supply.

Plumbers should complete all work in accordance with the *NSW Code of Practice Plumbing and Drainage*.

Please refer to Sydney Water's Plumbing Policy, Standards and Regulation Group for more information.

Consult your local council about regulations that apply to the installation of stormwater storage dams or tanks, treatment equipment and alterations to onsite detention systems.

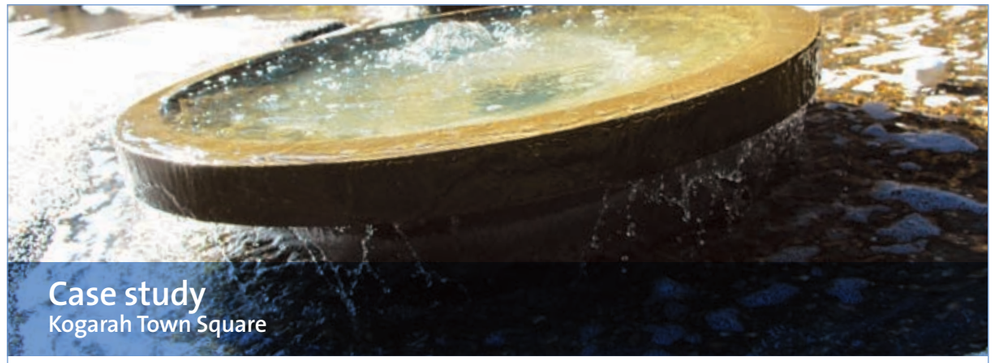
Costs and advantages

Costs of stormwater capture include pre treatment, piping, collection, treatment and the reticulation of treated water. Because stormwater catchments and stormwater quality vary so much, cost calculations need to be made for each project.

Reusing stormwater can reduce other development and maintenance costs, such as:

- reduce the required volume of stormwater discharge pipes
- reduce or eliminate the need for onsite detention systems
- reduce the need to install and maintain 'end of pipe' treatment systems, such as gross pollutant traps.

Case studies of stormwater capture in different types of developments are described below.



Case study
Kogarah Town Square

The Kogarah Town Square development comprises 193 residential apartments, 4,628 square metres of commercial and retail outlets and a town square with underground parking. The water management system in Kogarah Town Square was designed in a holistic water cycle management approach, focusing on water reuse and efficiency.

The three main principles under which the Kogarah Town Square project was developed as a best practice example of urban water collection, treatment and reuse are:

1. capturing stormwater from impervious areas
2. collecting rainwater from the roofs
3. reducing the demand of potable water through water conservation.

Eighty per cent of all water that falls on the site in a year (7,854 kilolitres) is reused.

From the impervious areas, stormwater passes through a gross pollutant trap that filters out the litter and large pollutants. The water is then collected in a storage tank and pumped to irrigate landscape areas. This saves up to 2,130 kilolitres of potable water a year. In addition, the landscape area acts as a filter for the water, removing the excess nutrients and fine particles. The filtered water is collected and stored in a separate tank and used as a primary top up supply for the other tanks.

From the roofs, rainwater is collected in a storage tank under the public car park. The water passes through a screen filter and is pumped for toilet flushing, car washing and into the water feature in the Town Square. This gives a savings of approximately 5,789 kilolitres of potable water a year.

Residential and commercial properties are fitted with water efficient devices such as flow restricted taps, 3 star rated showers, dual flush toilets, efficient urinals and dishwashers.

Photograph 15 – Water features at Kogarah Town Square are supplied with water from the site's rainwater and stormwater collection system.

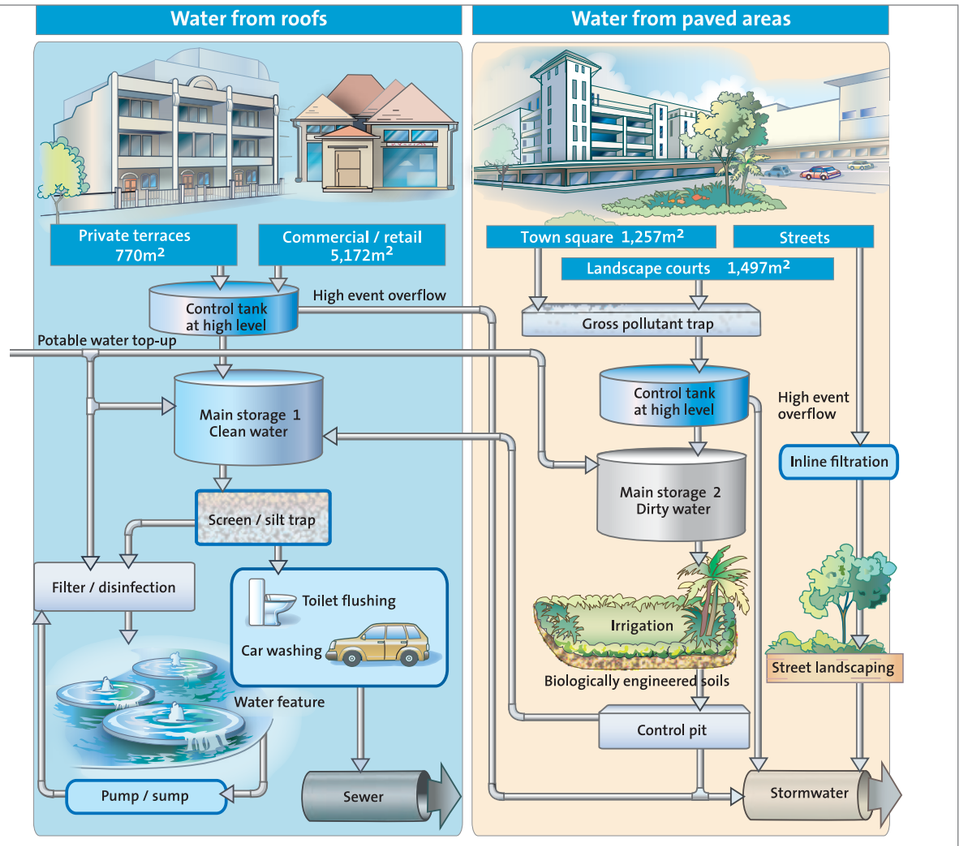


Figure 19 – The water reuse system at Kogarah Town Square

Useful documents

Managing urban stormwater harvesting and reuse 2006, Department of Environment and Climate Change NSW outlines some regulatory issues associated with stormwater harvesting and provides advice on how to plan a stormwater harvesting project.

Reference

Yuldeson, J, 2006, **Developing Green Case Studies**, National Association of Industrial and Office Properties, Herndon, USA.

Chapter 22

Groundwater

In some cases groundwater, sometimes known as bore water, may be a feasible alternative water source.

Accessing and managing groundwater

The Department of Water and Energy (DWE) regulates access to groundwater in New South Wales. Before you sink a bore you must first obtain a licence or an approval for the works from DWE. All bores must be constructed by a licensed driller.

The main reason for bore licensing is to ensure that this limited resource is equitably and sustainably shared among competing interests. It allows ready contact with licence holders incase significant resource management issues arise, such as water shortages or contamination.

There are groundwater embargoes in place for commercial use of groundwater around Sydney. In particular, these include the Botany Sands aquifer in the Eastern Suburbs of Sydney and around Botany Bay, as well as the Hawkesbury sandstone aquifer in the Blue Mountains area and parts of the Southern Highlands. These embargoes prohibit DWE from accepting new water licences.

Details of the embargo and water transfers can be obtained by contacting DWE.

In addition, there are areas of Botany Sands to the north of Botany Bay that have had groundwater extraction restrictions imposed as a precaution because of the likelihood that the groundwater may be contaminated. Domestic use in these areas is banned and industries are required to test their licensed groundwater extraction and demonstrate to DWE that the water quality remains of suitable quality for use.

Using groundwater

One of the most common uses for groundwater in commercial buildings is for cooling towers. Bore water generally has higher levels of dissolved solids than mains drinking water and may need to be treated before it can be used in cooling towers.

Groundwater is also commonly used for irrigation. This may only be cost effective if your shopping centre or commercial building

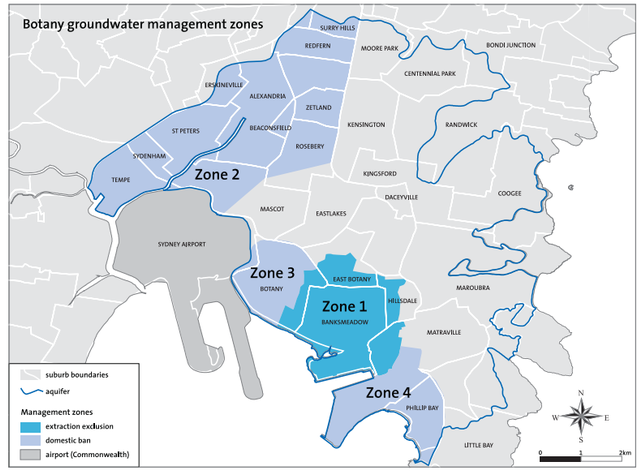


Figure 20 – Groundwater management zones for the Botany Aquifer, located south of Sydney.

has extensive landscaped areas. It is also important to consider the effect groundwater will have on soil quality, as it may contains high levels of dissolved salts.

Groundwater can be used to flush toilets and urinals. The University of New South Wales uses groundwater in some of its amenities and has trialled the use of groundwater in cooling towers.

Before using groundwater, you need to consider:

- what quantity of groundwater you need
- if the groundwater can deliver a sustainable yield
- what treatment the groundwater may need to undergo
- other land uses in the groundwater catchment and potential for contamination
- what approvals you need before drilling a bore and using groundwater.

Groundwater quality

Groundwater has higher levels of dissolved solids than mains drinking water. Some of the common contaminants in groundwater include dissolved iron, manganese and hydrogen sulphate. You should investigate the pH of groundwater and consider its likelihood to cause corrosion or scaling if it is not treated before use.

The amount of treatment groundwater needs will depend on its particular properties and the sensitivity of your end uses.

References

Frew, W, 2007, What a catch: the cricket oval that saves water in the Sydney Morning Herald, 22 January 2007, John Fairfax Publishers, Sydney. Also available online: http://www.smh.com.au/news/national/what-a-catch-the-cricket-oval-that-saves-water/2007/01/21/1169330767465.html

Case study
University of New South Wales aquifer recharge

The University of New South Wales (UNSW) uses water from the Botany Aquifer to irrigate its lawns and ovals and meet other non-drinking water demands such as toilet flushing and laboratory process water. UNSW is also using stormwater captured in the lower part of its campus to help recharge the aquifer.

UNSW has built a 10 metre wide percolation chamber under its cricket oval to collect stormwater from 70 per cent of the main campus. This water is allowed to seep back into the sands of the Botany Aquifer.

If the chamber fills up, it overflows into local stormwater drains that drain to Botany Bay.

UNSW expects to return 160 megalitres of stormwater to the aquifer, which is about 80 per cent of its current extraction. (Frew, 2007)

Photographs 16 and 17 – The University of New South Wales aquifer recharge system contributes to the Botany Aquifer - shown during construction (above) and the completed system (below) during a period of heavy rainfall.

Chapter 23

Wastewater reuse

Wastewater can be a valuable and reliable source of alternative water, however it requires proper management and treatment before it can be reused because it has been polluted with a range of contaminants.

Wastewater can be classified three ways:

Greywater includes wastewater from baths, showers, basins, laundries and kitchens. Greywater can be contaminated by human faeces especially if cloth nappies are being washed. Kitchen wastewater may also be regarded as greywater, but treatment and reuse is more complex because it may be alkaline and can contain large amounts of grease, fat, food waste and detergents.

Black water (domestic sewage) is wastewater from toilets and bidets that is heavily and directly contaminated with human wastes and contains contaminated solid material, such as toilet paper. Black water is likely to have high levels of bacterial contamination and can be highly infectious.

Sewage is a combination of black water and greywater, as well as trade waste from commercial and industrial activities.

Using greywater

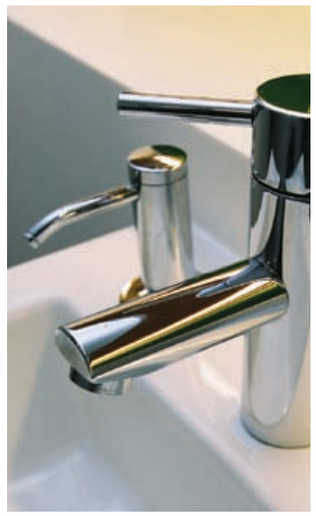
Greywater with low levels of pathogen contamination, oils and greases can be used for sub surface irrigation with little treatment. Greywater with higher levels of treatment can be used for above surface irrigation and indoor uses such as toilet flushing.

Before planning to reuse greywater, you need to:

- calculate how much greywater you generate and how much you can reuse
- identify the contaminants that your greywater contains
- decide on intended uses for the greywater, i.e. irrigation, toilet flushing
- determine how much contact people will have with reused greywater
- identify if there will be any environmental risks associated with greywater reuse
- decide on the treatment processes you will use
- determine if these treatment processes will remove contaminants and make water safe for users and the environment.

Preventing hazardous contaminants going into a greywater system is the best way of ensuring greywater quality. To do this you can:

- exclude kitchen waste because of high levels of oil, grease and bacterial contamination from food wastes



- exclude laundry water when items soiled with faeces or other excrements are washed because of high levels of bacterial contamination
- ensure cleaning and garden chemicals are not disposed of in the greywater system
- choose the right household cleaning products.

It is very important to communicate with building users and cleaners so that they understand what they can and cannot put down the drain and when water must be diverted to sewer.

If you plan to use greywater for irrigation, you must ensure that the volume of water will not be more than the holding capacity of the receiving soils.

There are two devices commonly available to reuse greywater:

Greywater diversion device

If you are confident that your greywater system excludes kitchen wastewater and does not have heavy pathogen loads, you can use a greywater diversion device to divert greywater to sub surface irrigation.

Sub surface greywater irrigation systems must be installed at least 10 centimetres underground to reduce human exposure to any potential pathogens.

Diversion devices are not allowed to store greywater because harmful pathogens can grow in storage tanks and unpleasant odours can develop. Any greywater that is not used for irrigation must be disposed of to sewer. To avoid waterlogging your soil, don't apply greywater after rain. Diversion devices must have a screen to remove any large pollutants, such as lint or twigs that could clog spray systems or pumps.

Greywater must be diverted to sewer if there is a known source of faecal contamination in the system or an outbreak of infectious disease amongst users of the buildings.

Diversion devices can be operated by gravity or pump. Pump devices have a surge tank that controls the amount of greywater sent to irrigation. The surge tank should not be used as a storage tank.

Greywater treatment system

A greywater treatment system must be used if greywater contains kitchen wastewater, or if you want to use greywater for toilet flushing, washing machines or unrestricted garden irrigation.

A complete greywater treatment system may include components such as wetlands, intermittent sand filters, soil filters, greywater septic tanks and aerated wastewater treatment systems. These processes remove pollutants including solids but will not remove harmful bacteria.

Disinfection is required where there will be human contact with reused greywater. When secondary treated greywater is disinfected using an active disinfection process such as chlorine, bromine, ozone or ultra violet light, it will reduce the levels of harmful bacteria and make greywater safe for more human contact.

Sewer mining and black water reuse

The amount of greywater generated onsite can sometimes be insufficient to meet your demand for recycled water and it may be more efficient to use blackwater or sewage. While these wastewater streams are more heavily contaminated and require more treatment, having a larger volume of wastewater to treat might be more cost effective.

Building owners can either use the sewage generated on-site, or access nearby sewer mains. Accessing wastewater in nearby mains is known as sewer mining. Approval is required from the relevant local council and Sydney Water.

Organisations who want to sewer mine should discuss their plans with Sydney Water to make sure the project is possible and the existing sewer infrastructure can cope with the proposed project. If the project is feasible, Sydney Water will provide initial development approval and construction approval.

Approvals and plumbing regulations

In New South Wales, local government approval is required to install and operate systems of sewage management that service more than one household. This requirement applies to greywater reuse systems.

Approval must be in accordance with the Local Government Act 1993 and Regulations.

In New South Wales, the Department of Water and Energy (DWE) and NSW Health can advise local councils when they are processing the applications.

Local government approval is not required where, under the Protection of the Environment Operations Act 1997, an environment protection licence is in force for a sewerage management scheme.

It is strongly recommended that recycled water schemes comply with the NSW Government guideline for the Management of Private Recycled Water Schemes.

To manage the risks of a recycled water system and gain approval to install and operate, you should:

1. conduct a risk assessment on the sources of wastewater and its intended uses
2. ensure the treatment system has multiple barriers
3. ensure disinfection is included as a treatment process
4. identify the system's critical control points
5. understand how the system of wastewater collection, treatment and reuse works
6. develop a system management manual
7. test and validate the system's performance for 12 weeks after approval to install the system is received
8. conduct a further four weeks of testing after approval to operate the system is received
9. undertake continuous online monitoring and regular manual monitoring when the system is operating and divert the system to sewer if critical control points are breached
10. ensure a person or organisation has responsibility for managing the system

11. think about additional ways you can manage recycled water in the building, ie signs, education, coloured plumbing pipes and fixtures and regular plumbing compliance checks to detect cross connections

12. ensure the system complies with plumbing requirements of the local authority

If your wastewater reuse system will be operated in Sydney, notify Sydney Water's Plumbing and Policy of any changes to your plumbing. Plumbing requirements for recycled water installation are outlined in the most recent edition of the **New South Wales Code of Practice: Plumbing and Drainage**.

Sydney Water will review your system to make sure there are no potential health threats, such as cross-connections between your drinking water supply and your greywater system.

You should also talk to your Sydney Water trade waste representative to make sure that changes to the quantity or quality of wastewater you intend to dispose of to sewer will not affect your Trade Waste Agreement.

Useful documents

- **Australian Guidelines for Water Recycling: Managing Health and Environmental Risks. National Resource Management Ministerial Council (NRMMC)**, Environment Protection and Heritage Council (EPHC) and Australian Health Ministers Conference (AHMC), 2006. This document outlines how to approach a risk-based approach to recycled water systems.

- **Advisory Note 4: Sewage Management Facility Accreditation Criteria Based on the Final Application of Treated Effluent and Risk of Disease Transmission**, NSW Health, 2006.

- **Management of Private Decentralised Recycled Water Systems** (draft), NSW Department of Energy, Utilities and Sustainability.

Costs and advantages

Wastewater can provide a regular source of alternative water and well run systems can significantly reduce demand on drinking water supplies.

Greywater treatment systems and costs may be simpler than black water and sewage reuse projects, but as most commercial buildings have more access to black water or sewage than greywater, it may be more feasible to reuse this waste stream.

In commercial buildings, the costs of designing systems to comply with regulatory and health requirements, then testing, maintaining and monitoring them may be high.

Given the costs of setting up a well running wastewater reuse system, it is important that you have an accurate idea of how much greywater you will be collecting and how much you will be using.

It is advisable to conduct an audit or an irrigation assessment before designing your system. Reuse projects will be most successful when all stakeholders are committed to operating a viable system that produces good quality water.

Case study
Wastewater reuse in Melbourne

Two commercial office buildings in Melbourne demonstrate the possibilities of wastewater treatment and reuse.

Urban Workshop at 50 Lonsdale Street and Southern Cross on the corner of Bourke and Exhibition Streets are both occupied by Victorian Government staff. Combined, the two buildings save 47 megalitres of drinking water a year by treating and reusing about 75 per cent of their sewage and greywater. After treatment, recycled water is returned to rooftop tanks for use in toilet flushing. However, the water is too salty to be used in cooling towers without additional treatment.

Both buildings use a three stage process to treat their wastewater. The primary treatment screens solids, the secondary treatment uses microbes to break down organic matter and membrane treatment to filter microscopic contaminants, and the tertiary treatment disinfects using ultraviolet radiation and chlorine.

Similar systems will be installed in three more multi-story office buildings in Melbourne in coming years. (City West Water, 2007).

Photograph 18 – Southern Cross on the corner of Bourke and Russell Streets (left) and the Urban Workshop at 50 Lonsdale Street (right) are two Melbourne buildings that demonstrate how wastewater can be treated and reused at a commercial location.

References

Turning waste into a resource, Liquid Assets, Issue 2, 2007 City West Water, Sunshine, Victoria.

Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1) 2006 National Resource Management Ministerial Council (NRMMC), Environment Protection and Heritage Council (EPHC) and Australian Health Ministers Conference (AHMC).

Sewage Management Facility Accreditation Criteria Based on the Final Application of Treated Effluent and Risk of Disease Transmission, NSW Health, Advisory Note 4 – May 2006, http://www.health.nsw.gov.au/public-health/ehb/general/wastewater/adnote4.pdf.

Part 4

Water saving checklist

Part 4 of **Best practice guidelines for water conservation in commercial office buildings and shopping centres** provides a practical Water Saving Checklist that shows you how well you manage water. The checklist will help you work your way through these guidelines and identify opportunities for water conservation in your commercial building or shopping centre.

Water saving checklist

Managing your water	Answer Yes / No	Recommended action
Do you monitor and record your water use?	Yes ☐ No ☐	If No, read your meter at least daily, or install a continuous monitoring system. Record meter reading information so you can identify changes in water use.
Do you benchmark your water consumption?	Yes ☐ No ☐	If No, calculate a L/m²/annum figure and compare it against other buildings in your portfolio and the benchmarks in Chapters 3 and 4.
Do you know where water is used in your office building or shopping centre?	Yes ☐ No ☐	If No, look at the average water balance graphs in Chapters 3 and 4 for guidance. Install sub meters according to the priorities in Chapter 9 to develop your own water balance.
Do you know where the best opportunities to save water are?	Yes ☐ No ☐	If No: - check for leaks - check cooling tower operations - install flow restrictors on taps - remove all cyclical flush urinals - develop a water balance for your building and see where you are using most water
Do you regularly review your company's water management?	Yes ☐ No ☐	If No, use the One-2-Five® Water or Water Achiever process offered through the EDC Business Program and concentrate on achieving identified critical actions. Use the template provided in the *NSW Water Saving Action Plan* guidelines. Compare your results to previous reviews and rate your achievement of critical actions.
Do you review your sub meters, or information from your continuous monitoring system regularly?	Yes ☐ No ☐	If No, establish work procedures so that a member of staff is responsible for water use information and knows what they need to do to if water use changes.
Do you know how much water, and all associated charges (energy, pumping, chemical, sewer discharge) are costing your business?	Yes ☐ No ☐	If No, refer to information about the true cost of water in Chapter 6. Calculate your own water costs and associated charges, as knowing how much your water costs will establish a business case for water conservation.
Have you developed a water savings plan?	Yes ☐ No ☐	If No, look at the findings of this checklist then develop a water balance and a basic savings plan.
Do you have signs, posters and stickers in your building to encourage water conservation and remind people to report leaks?	Yes ☐ No ☐	If No, business partners in the EDC Business Program can co-brand stickers, posters and shower hangers.

Amenities	Yes / No	Recommended action
Have you installed sub metes on supply lines to amenities and hot water supply?	Yes ☐ No ☐	If No, install meters on supply lines to amenities, as described in Chapter 9. Conduct routine inspections and program maintenance to detect problems before they become large leaks.
Does your building have any cyclic flushing urinals?	Yes ☐ No ☐	If Yes, replace urinals immediately with manually flushing urinals, automatic sensor units or ultra low flow or waterless urinals. Refer to Chapter 13.
Does your building have automatic on-demand urinal sensor flushing systems?	Yes ☐ No ☐	If Yes, regularly check that sensors are working properly and not detecting unrelated movement. Check that solenoids are operating correctly and replace them if they are faulty or worn.
Does your building have single flush toilets?	Yes ☐ No ☐	If Yes, replace single flush toilets in high use areas with 6/3 litre or 4.5/3 litre dual flush models. If toilets are in low use areas, restrict cistern volume and bring forward programmed replacement.
Does your building have dual-flush toilets?	Yes ☐ No ☐	If Yes, check the flush capacity. Older 11/5.5 litre and 9/4.5 litre dual flush toilets can be replaced with new 6/3 litre or 4.5/3 litre flush models.
Are cistern rubber seals on toilets replaced regularly?	Yes ☐ No ☐	If No, cistern rubber seals should be replaced every two years to prevent leaks.
Do you have a flusherette system?	Yes ☐ No ☐	If Yes, check the flow rate and flush timing. Over time, wear will cause excessive flush volumes. Insert flow control regulators into valve bodies to reduce flow.
Do you have flow regulators in all hand basins?	Yes ☐ No ☐	If No, install flow regulators so that flow is reduced to at least 6 litres per minute.
Do you have water efficient showers?	Yes ☐ No ☐	If No, install flow regulators so that flow is reduced to at least 9 litres per minute or install WELS 3 star rated showerheads.

Continued overleaf

Cooling tower operations	Yes / No	Recommended action
Does your building have cooling towers?	Yes ☐ No ☐	If Yes, continue with this section. If No, go to the next section.
Is there a water meter on the make up water pipe?	Yes ☐ No ☐	If No, install a sub meter and monitor the water consumption regularly.
When the pump is stopped, is there water flowing from the overflow drain pipe?	Yes ☐ No ☐	If Yes, check that the drain valve is correctly set and if there are any leaks. Check if the valve is closed and adequately sealed.
When the pump is stopped, does the water flow out of the overflow drain pipe whilst the water is coming in through the make up water line?	Yes ☐ No ☐	If Yes, this indicates that the ball float valve is incorrectly set. The ball float valve needs to be reset.
If you have a V shaped basin, when the pump stops does the cooling tower overflow?	Yes ☐ No ☐	If Yes, consider installing a break tank, or a more precise make up control.
If there is a significant length of condenser water pipe work running at high level, causing the tower overflow when the pump stops?	Yes ☐ No ☐	If Yes, consider reconfiguring the pipework.
If you have two or more cooling towers interconnected, when the pump stops does water flow from the drain pipe?	Yes ☐ No ☐	If Yes, check the ball float valve settings and the height of the tower basin. If one basin is higher than the other some modifications may be required.
Is the water overflowing the edge of the tower basin?	Yes ☐ No ☐	If Yes, check that the overflow pipe is set correctly or not blocked.
Is the area around the tower regularly or constantly wet?	Yes ☐ No ☐	If Yes, water is splashing out of the tower. Install or replace anti splash louvres.
Is any leakage present in the tower, casing, basin, or any intake or exhaust ducts or flexible connectors?	Yes ☐ No ☐	If Yes, joints need to be adjusted and sealed.
Does the cooling tower have drift eliminators, or old or ineffective eliminators?	Yes ☐ No ☐	If No, install a drift eliminator that limits drift loss to no more than 0.002 per cent.
Do any pumps have packed gland pump seals?	Yes ☐ No ☐	If Yes, ensure pumps are inspected monthly and seals tightened as needed. Also consider replacing the seals with mechanical seals.

Cooling tower operations	Yes / No	Recommended action
Does your water treatment contractor clean the conductivity sensor every month?	Yes ☐ No ☐	If No, make this part of their ongoing duties. Ensure it is recalibrated every month.
Is the water treatment system installed with a bleed blockout?	Yes ☐ No ☐	If No, install a bleed blockout to ensure that unnecessary bleed does not occur during chemical dosing.
Does the cooling water system have a side stream filter that uses water for back flushing purposes?	Yes ☐ No ☐	If Yes, consider capturing the bleed off in a backwash holding tank and then using it to backwash the side stream filter.
Have you contacted your water treatment contractor to discuss increasing the cycles of concentration in your cooling tower to reduce the bleed rate?	Yes ☐ No ☐	If No, ask your contractor to do so. Water supply in Sydney should be able to be cycled to about 9. If your contractor is unable to do this, discuss opportunities of changing to a treatment system that can function effectively at high cycles of concentrations.
Does your cooling tower water treatment contract require the contractor to report back on all water leaks after each service?	Yes ☐ No ☐	If No, amend contract to ensure this occurs.
Do you have a certificate stating that an effective process of disinfection is installed and operating?	Yes ☐ No ☐	If No, make sure your contractor can supply one. These certificates are mandatory in New South Wales.

Continued overleaf

Cooling systems and building design	Yes / No	Recommended action
Have you integrated economy cycle or fresh air venting into your air conditioning system?	Yes ☐ No ☐	If No, investigate if this can be done with your current HVAC equipment.
Have you reduced the heat load in your building as far as possible?	Yes ☐ No ☐	If No, install energy efficient lighting, building insulation, external shading, high performance insulation, sympathetic landscaping, and heat efficient natural lighting.
Is your cooling load under 500 kWR?	Yes ☐ No ☐	If Yes, you should investigate the possibility of air cooled systems. In smaller systems, air cooled systems can be appropriate because they do not consume water and have lower maintenance costs.
Have you looked at alternative water sources for your cooling system?	Yes ☐ No ☐	Lake water, groundwater, sea water, reclaimed water, recycled water, rainwater and condensate may all be used in cooling systems.
Have you considered other cooling systems?	Yes ☐ No ☐	If No, investigate options including evaporative pre-cooled air cooled condensers with pad or spray cooling, variable refrigerant volume systems, hybrid coolers or condensers, phase change materials or chilled beam technology. These are viable alternatives to traditionally cooling towers and should be investigated when building or renovating.
Kitchens and food courts	**Yes / No**	**Recommended action**
Are the water supply lines to kitchens sub metered?	Yes ☐ No ☐	If No, install sub meters on the supply lines to food businesses, especially high volume, water intensive kitchens.
Do you benchmark water use in each of the kitchens or your food court?	Yes ☐ No ☐	If No, use sub metering information to establish benchmarks so you can track kitchen water use over time. Common benchmarks are litres per cover, litres per meal served, or litres per patron.
Do you have flow regulators on kitchen sinks and basins?	Yes ☐ No ☐	If No, install 9 or 12 litres per minute flow restrictors on kitchen sinks and 6 litres per minute restrictors on hand basins.
Do you have waterless woks in your kitchen?	Yes ☐ No ☐	If No, consider installing a waterless wok. You may be able to get information and financial assistance from the Ethnic Communities Council of NSW. If you are accepting new tenancies into your food court, make the installation of waterless woks a lease condition.
Do you have a water efficient dishwasher?	Yes ☐ No ☐	If No, replace your existing model with a water efficient model. You will save money through water and energy savings.

Kitchens and food courts	Yes/No	Recommended action
Do staff in food courts and kitchens operate dishwashers and glass washers efficiently?	Yes ☐ No ☐	If No, ensure all staff receive information about water efficient dishwasher information. If you are accepting new tenancies, make installation of water efficient dishwashers and glass washers a lease condition.
Do staff in food courts and kitchens rinse plates before washing?	Yes ☐ No ☐	If Yes, install water efficient 6 litres per minute WELS rated pre-rinse spray valves. Sydney Water is offering a rebate system for their installation.
Do you check the condition of pre rinse spray valves?	Yes ☐ No ☐	If No, inspect pre rinse spray valves every two weeks to check for leaks and worn valves. Worn valves waste water and reduce cleaning efficiency.
Do staff in food courts and kitchens leave taps running while they are cooking and cleaning?	Yes ☐ No ☐	If Yes, install signs to remind staff to turn taps off. Consider installing sensor taps or foot operated taps. Waterless woks have hip controls and automatic turn off swivel taps.
Are kitchen floors and food court areas hosed down?	Yes ☐ No ☐	If Yes, consider using mops or squeegees instead of hoses. Microfibre mops are highly water efficient. If hoses must be used, ensure they are fitted with trigger nozzles.
Is food ever defrosted under running water?	Yes ☐ No ☐	If Yes, ensure all food is defrosted in a refrigerator, or in a microwave if it is to be cooked immediately.
Are water cooled steamers used?	Yes ☐ No ☐	If Yes, install more efficient steamer equipment. Efficient steamers can use up to 90 per cent less water and up to 60 per cent less energy than older models and have shorter cook times, higher production rates and reduced heat losses.
Do tenants pay for their own water consumption?	Yes ☐ No ☐	If No, you may be able to establish leases so that sub metering information can be used to charge tenants for their water consumption. This gives each tenant a financial incentive for water conservation.
Fitness centres	**Yes / No**	**Recommended action**
Does your building contain a fitness centre?	Yes ☐ No ☐	If Yes, continue with this section. If No, go to the next section of this checklist.
Are the showers water efficient?	Yes ☐ No ☐	If No, install 9 litres per minute flow restrictors or WELS 3 star rated showerheads on showers.
Do you have flow regulators in all hand basins?	Yes ☐ No ☐	If No, install flow regulators so that flow is reduced to 6 litres per minute or less.
Does the fitness centre contain a swimming pool?	Yes ☐ No ☐	Ensure you sub meter supply and refer to the Sydney Water fact sheet Swimming pools for benchmarking and water conservation information.

Continued overleaf

Outdoor areas and water features	Yes / No	Recommended action
Do you have a landscaped area or water features?	Yes ☐ No ☐	If Yes, continue with this section.
Do you sub meter your irrigation supply and water features?	Yes ☐ No ☐	If No, consider installing sub meters to determine your water use and identify leaks. This is especially important if you have large areas of irrigated areas or large water features.
Do you improve your soils?	Yes ☐ No ☐	Improving soil quality can improve plant growth and water retention. Add organic matter such as compost or composted animal manure.
Do you use an alternative water source to irrigate your garden?	Yes ☐ No ☐	If No, consider using rainwater, stormwater or treated wastewater for irrigation.
Cleaning	**Yes / No**	**Recommended action**
Do you communicate with cleaning staff regularly?	Yes ☐ No ☐	If No, cleaning staff will need information about water wise cleaning techniques and the correct way to clean specialized equipment such as waterless urinals. You can use Sydney Water EDC Business Program stickers, poster and fact sheets to communicate with staff.
Do cleaners hose down floors or carparks?	Yes ☐ No ☐	If Yes, remember that water restrictions prohibit the hosing of hard surfaces. Use brooms or mops to clean floors, or use rainwater or other water sources if you must use the hose. In most large carparks, commercial street / foothpath cleaning equipment can be used.

Appendix

Sydney Water benchmarks explained

Office building benchmarks

The water use efficiency benchmarks presented in Chapter 3 of these guidelines were developed with information gathered from 31 water efficiency audits conducted by the EDC Business Program. The buildings used in the sample were large and fitted with cooling towers.

Benchmark	Offices with cooling towers
Average practice and no leaks	1.01 kL/m²/year
Economic best practice (median of implementing water saving projects with two year paybacks)	0.84 kL/m²/year
Very well managed building	0.77 kL/m²/year

Office building benchmarks – without cooling towers

Benchmarks for buildings without cooling towers were developed by taking out the proportion of water use attributed to cooling towers. These adjusted benchmarks have not been verified against the population and should be interpreted as an indicative estimate.

Benchmark	Offices without cooling towers
Average practice and no leaks	0.64 kL/m²/year
Economic best practice (median of implementing water saving projects with two year paybacks)	0.47 kL/m²/year
Very well managed building	0.40 kL/m²/year

Office building benchmarks – with small retail areas

Benchmarks were also derived for office buildings that supply water to one or more retail tenants in the building. These benchmarks can be used if you are unable to separate the water consumed by retail tenancies within your office building.

Benchmark	Offices with small retail areas on common meters
Average practice and no leaks	1.08 kL/m²/year
Economic best practice (median of implementing two year paybacks)	0.90 kL/m²/year
Very well managed building	0.82 kL/m²/year

These adjusted benchmarks account for the additional water consumption used by retail activities within your building. They are derived based on the average impact of retail on office buildings within the sample sets – typically up to one level of retail in a multi level office tower.

The benchmarks should be interpreted in this context and may not be appropriate for large retail or food court installations. If you have large retail or food court areas in your building, install more sub meters to make sure you can keep track of water use.

Glossary

ABGR The Australian Building Greenhouse Rating System.

Backflow The unwanted reverse flow of water in the potable water system.

BASIX BASIX is a regulatory tool applied to new houses, home renovations and multi-unit dwellings in NSW

Bleed The water that is removed from a cooling tower to reduce the concentration of dissolved and suspended solids.

Cooling load The amount of heat which needs to be removed to keep an occupied building at a set temperature and the energy required to do this.

Cycles of concentration The number of times the concentration of dissolved and suspended solids in cooling tower water is increased because of evaporation. Four cycles of concentration means the concentration of solids has been increased by four.

Drift Water lost from a cooling tower as liquid droplets within the exhaust air. Drift does not include condensation.

GLA Gross Lettable Area is the floor space of a tenancy in a shopping centre.

HVAC Heating, ventilation and air conditioning.

Greenstar Greenstar is a building environmental rating system for buildings run by the Green Building Council of Australia.

LEED LEED is a USA standard for the design, construction and operation of high performance green buildings.

Legionella Bacteria that can cause a type of pneumonia is called Legionnaires Disease. Legionella bacteria can multiply rapidly in wet, warm conditions.

NABERS The National Australian Building Rating System, a voluntary building performance rating tool.

NLA Net Lettable Area, the floor space of a tenancy in a commercial office building.

One-2-Five® Water A management diagnostic process that analyses qualitative or non technical measures that all businesses must address to achieve sound water management. One-2-Five® is a patented process of Energetics Pty Ltd.

Phase change materials Materials that can store and release heat. Active phase change materials can change state, for example ice has a capacity to cool warmer, ambient air and absorb heat by melting.

Pre rinse spray valve A handheld nozzle used to remove food scraps from dishes before they washed.

Solenoid An electro mechanical device that activates a valve.

Splash In cooling towers, the water that can be lost because of falling water in the tower, or strong winds blowing through the tower.

SUDF Sewerage Usage Discharge Factor is a measure of the ratio of water going out of your business through the sewerage system compared to water coming in from Sydney Water mains.

Thermal Mass The amount of time building materials take to gain or release heat. A building with a high thermal mass will be more energy efficient because internal temperatures will not swing with outside air temperatures.

WELS Water Efficient Labelling Scheme. As part of the Water Efficient Labelling and Standards program, WELS gives products a star rating according to their water efficiency. An overview of water consumption required for WELS ratings is shown in Chapter 13 of these guidelines.

WaterMark™ WaterMark™ certification shows that water supply, sewerage, plumbing and drainage goods meet quality standards.

Wet bulb temperature The lowest temperature that can be obtained by evaporating water into the air at constant pressure. Wet bulb temperature will be lower than dry bulb temperature in the same conditions.

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Part 2 Technical water saving information

Part 2 Technical water saving information (continued)

Part 3 Alternative water sources

Every Drop Counts Business Program

Sydney Water's Every Drop Counts (EDC) Program helps large water using businesses, including commercial property owners and managers, save water by better management and cost effective technical measures.

Small to medium water using businesses can also use information provided by the EDC Business Program, such as fact sheets, best practice guidelines and marketing materials.

Contact us

For more information about the EDC Business Program, contact:

Email EDCBusiness@sydneywater.com.au

Phone 1800 661 161

Fax 02 9350 5942

Website www.sydneywater.com.au