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

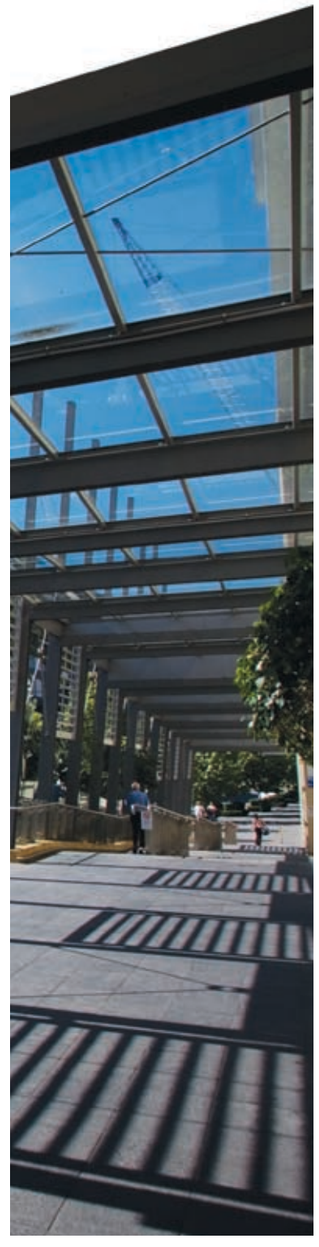
Leaking hot water from showers, basins and kitchens can cost thousands of dollars a year in water and energy. Every kilolitre of wasted hot water costs up to $6.34 if you take into account the costs of metered water, wastewater and trade waste discharge and heating.

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.

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.

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.

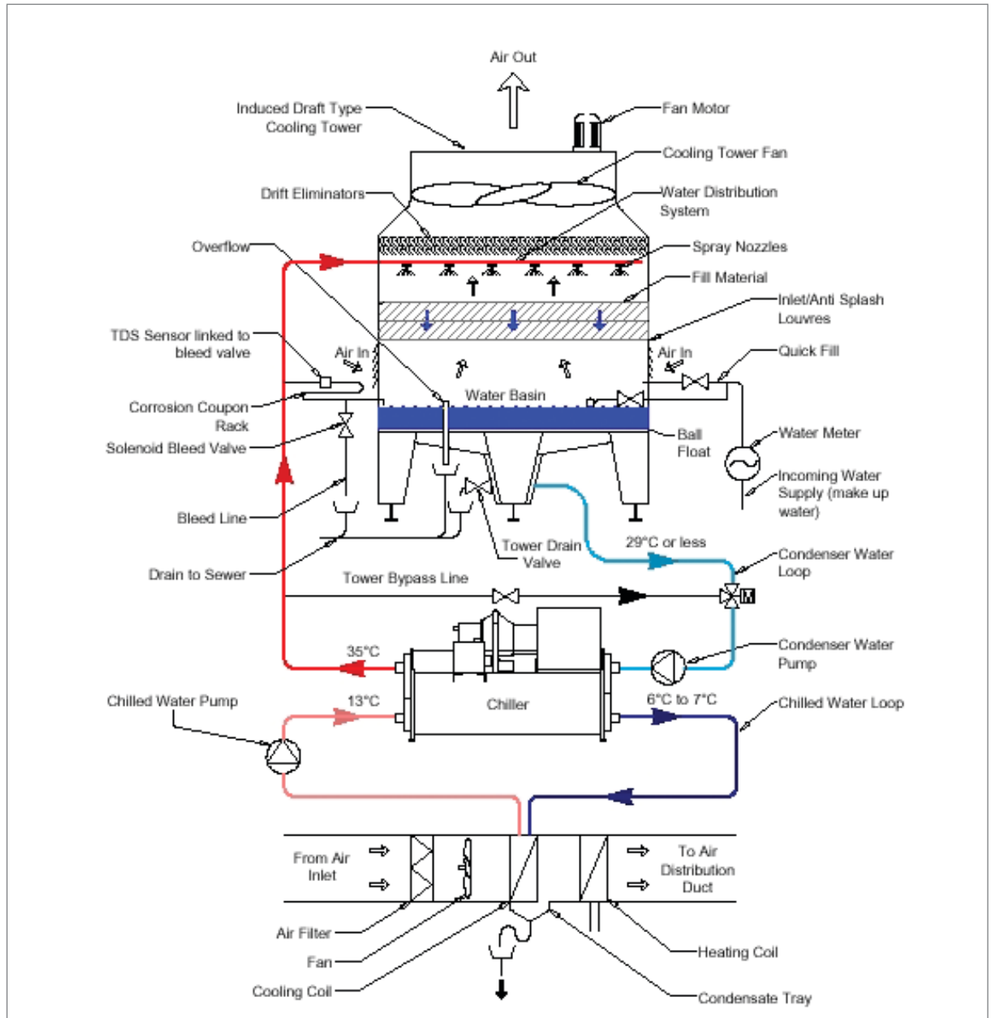


Figure 15 – Key features of a typical cooling tower.

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.

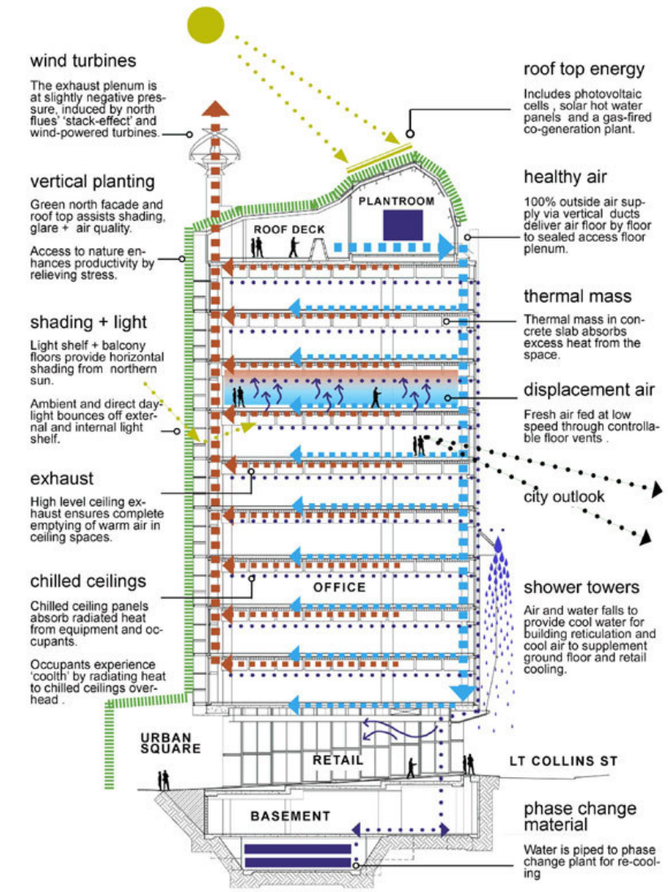
Alternatives to cooling towers

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.

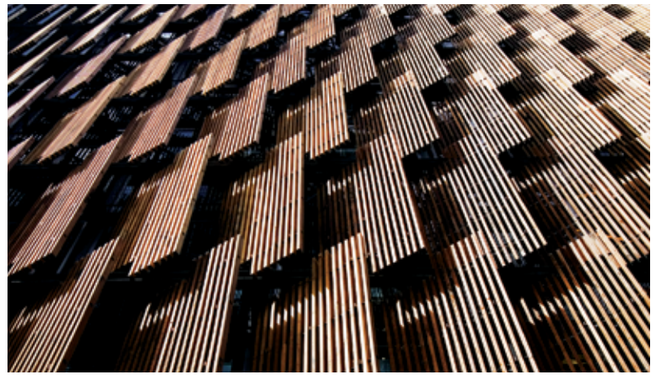
Alternative cooling may have lower cooling loads than traditional air conditioning systems, meaning greater use has to be made of design features to reduce indoor and outside heat gain and improve a building's thermal mass. Melbourne's CH2 building has incorporated a range of passive solar and alternative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

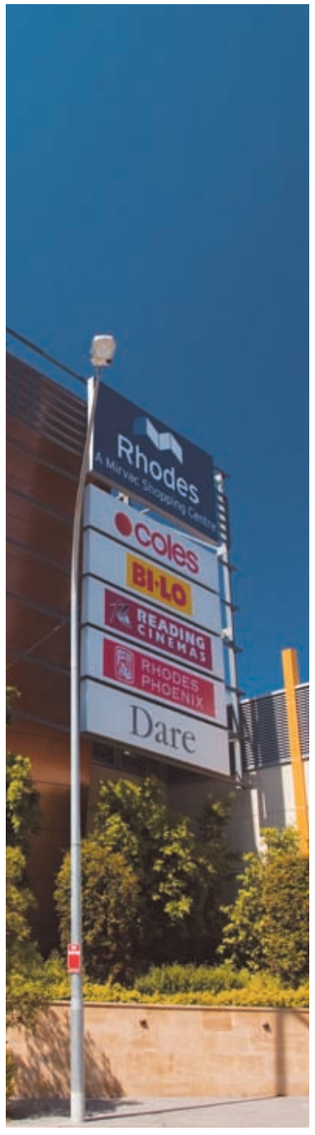


Table 14 – Common sources of heat found in shopping centres and suggested solutions to reduce heat load (Department of Industry, Tourism and Resources 2003–04).

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.

References

City of Melbourne 2006, Technical Research Paper 08: The Building Structure and the Process of Building http://www.melbourne.vic.gov.au/rsrc/PDFs/CH2/Research8.pdf [Accessed 8 February 2007]

Bovis Lend Lease 2003, *Lend Lease Unveils Australia's First Five Star Greenhouse Office Building* http://www.bovislendlease.com/llweb/llc/main.nsf/all/news_20030430 [Accessed 4 January 2006]

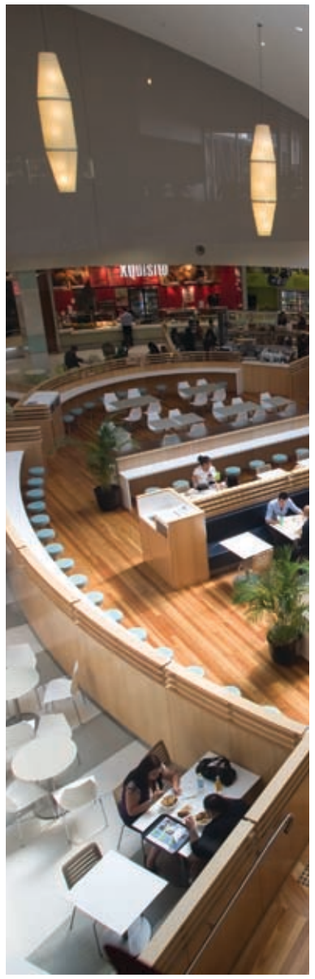
Department of Industry, Tourism and Resources 2003, *Case Study: Achieving Results in the Bread Baking Sector*, http://www.industry.gov.au/assets/documents/itrinternet/BakersDelightCaseStudy20050620141331.pdf [Accessed 15 January 2007]

Department of Industry Tourism and Resources 2004, *Case Study: Retail Supermarkets Sector*, http://www.nml.csiro.au/assets/documents/itrinternet/Coles_case_study20040907111052.pdf [Accessed 15 January 2007]

Planet One Sustainability Strategies and RMIT Centre for Design 2003, *Building Greener Shopping Centres: An Introduction to Sustainability for Neighbourhood Shopping Centre Developers* [http://www.cfd.rmit.edu.au/services/publications_web_tools/articles/building_greener_shopping_centres [Accessed 8 January 2007]

Solutions to the demand problem, AIRAH, in Ecolibrium June 2007, pages 30–31.

Using phase change materials (PCMs) for space heating and cooling in buildings, Bruno, F, in EcoLibrium March 2005, pages 26–31.



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

References

Othman, M and Jayasuriya, N, 2004, Water http://www.melbourne.vic.gov.au/rsrc/PDFs/CH2/Study7TechnicalPaper_updated.DOC [Accessed 30 August 2007].

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.

References

Department of Energy, Utilities & Sustainability (DEUS), 2007, Water Savings Projects – Round 2, Sydney

http://www.deus.nsw.gov.au/Water/Water%20Savings%20Fund/Water%20Savings%20Fund%20Projects/Round%202%20-%20Sydney.asp#P215_25529 [Accessed 15 January 2007]

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.