SQUARE SAVINGS

As a multi-faceted public space precinct, Melbourne's Federation Square faces a unique set of environmental and operational challenges. But, as Sean McGowan reports, through the careful management of its cooling tower system the site is on target to reduce water consumption by 26 per cent.

Located on the corner of Swanston and Flinders streets in the heart of Melbourne, Federation Square is a hub for commercial, cultural and community activities.

It's hard to believe now, but the design chosen from a two-stage international competition was considered a controversial decision in 1996.

Yet since the project's completion a little more than 12 years ago, Federation Square has gone on to have been widely embraced by locals and visitors alike. The 3.8 hectare site attracts more than 10 million visitors annually to its major public events, art galleries, exhibition spaces and array of cafes, restaurants and bars.

The multi-faceted nature of the precinct creates a unique set of challenges in terms of the consumption and management of water and energy.

In 2007, Federation Square's management team developed a comprehensive environmental management plan. The plan continues to underpin the site's daily operations, and focuses on the delivery of environmental sustainability across six categories: water, waste, energy, air, noise and landscaping.

Of course, much of this work remains hidden from public view. But the achievements to date are nonetheless substantial.

Federation Square is not only on target to be carbon neutral by the end of 2014, but it has also saved approximately 89 million litres of water in the five years preceding June 2013.

And now, through the Victorian state government's Greener Government Building (GGB) Program, further water savings are being sought that will see a site-wide reduction of 26 per cent achieved.

BEGINNING BELOW

Long before sustainability and water management were front of mind, the designers of Federation Square literally laid the foundations of the water and energy savings that would follow a decade later.

Beneath the cobbled stone civic square and assortment of buildings lies a 1.4km passive cooling system known as a thermal labyrinth.

This concrete maze was designed to sit within the void between the square and the railway yard below. It makes clever use of the site's position next to the Yarra River to passively cool The Atrium, Deakin Edge and other public spaces during summer, as well as supplementing heating during winter.

Taking advantage of Melbourne's unique climatic conditions, cool air is drawn from the Yarra and pumped through the labyrinth's cells at night, cooling the concrete walls. Then during the day, air is gently pushed through the cells and naturally cooled by these walls before being directed into The Atrium via a low-velocity displacement system.

In peak summer conditions, this system is capable of delivering air that is up to 12°C below the external temperature – using a fraction of the energy used by conventional air conditioning.

In winter, the thermal mass of the labyrinth maintains an inherent warming potential that can be used to supplement heating to these spaces as required.

But such are the mixed-use spaces found across Federation Square that the thermal labyrinth is unable to meet all conditioning needs by itself.

Air conditioning for the gallery and exhibition spaces, as well as commercial buildings, is supplied courtesy of four cooling towers and an air conditioning plant concealed on the roof of the site's carpark.

This system is particularly critical to the conditioning of The Ian Potter Centre: NGV Australia art gallery, where the artwork on display requires a closely

controlled environment of 22°C (plus or minus a very small margin) and 50 per cent humidity.

And, of course, this system requires water, especially during Melbourne's summer.

"Federation Square has three twin-cell towers and one single-cell cooling tower that provide condenser water to the site's chillers," says Victor Anastasiadis, mechanical services manager at Federation Square.

"These chillers serve all areas of the site, incorporating tenancies, public use and office spaces."

The towers also provide condenser water for the various water-cooled condensing units that typically serve Federation Square's cool rooms, freezers and other supplementary cooling units.

TARGETED REDUCTIONS

Such was the demand for air conditioning of these spaces that the cooling towers once accounted for more than 60 per cent of the precinct's total potable water use.

This figure was significantly reduced in 2006 as part of a trial with City West Water. Then in 2011, through the GGB Program, Federation Square engaged Siemens to work with the operation's team to investigate further energy-efficient technologies and solutions across the site.

This program's Green Water initiatives sought to reduce water use through the implementation of a range of new infrastructure. This included infra-red sensors on amenities taps, low-flow tapware and aerators, waterless urinals, and expanded water harvesting.

Importantly, a revised cooling tower and chiller strategy was also recommended. This included an analysis around the site's cycles of concentration, the subject of which is covered in AIRAH's recently released video, "Maintain your cool".

Complementing best practice guidelines developed by AIRAH, the video explores water conservation and efficiency in cooling towers, and takes the viewer through the Federation Square experience, as well as the 1 Spring Street building.

Engagement: lessons from the mechanical services manager

Victor Anastasiadis | Mechanical services manager | Federation Square

"One of the key lessons for anyone undertaking this process is to work closely with people who understand your site and are fully across the outcomes you are looking to achieve," says Anastasiadis.

"It was important for Federation Square to lay the foundations for a clear framework and scope for the review, so that all parties had a distinct direction as to where we wanted to head. This has been one of the key factors to our success thus far – and has meant that time and resources could be implemented in the most effective way."

According to Anastasiadis, AIRAH's best practice guidelines helped Federation Square's mechanical services team develop its risk management plan. It also led them to consider increasing the site cooling towers' cycles of concentration.

"The key to increasing cycles of concentration at Federation Square was that we needed to fully understand our water consumption profile," says Anastasiadis.

"We needed to be aware of how much water we were using, and that means that each make-up water point on our cooling tower system needed to be monitored – as well as the monitoring of our bleed water."

Therefore, the first step was to install a smart meter system that provides data on the cooling towers' water use.

"This system also has the ability to be programmed, so that it will notify the Fed Square operations team of any erroneous water use."

With metering installed, the team then needed to determine the initial make-up water volume and review the cycles of concentration present at the time.

That review was followed by close consultation with the site's water treatment service provider, SAS Water Solutions. This was done to determine a level of cycles of concentration that would produce the best outcome for the site.

A still from AIRAH's "Maintain your Cool" cooling towers video.

Among the factors considered in this analysis were the optimal operating efficiency of the system, and the extent to which the cycles of concentration would impact on system corrosion controls.

Also considered was the effect of changes on system pH levels that would, therefore, effect chemical dosing and broader water treatment controls was.

"Cooling tower systems are required to be maintained in order to reduce the inherent risk of becoming a source of Legionnaires' disease," says Anastasiadis. "Therefore it was important to us to put in place a system that would provide useful information on the performance of the cooling tower system and at the same time, serve as a valuable tracking tool for our cooling tower water treatment and overall water use."

An automated tower management system was therefore proposed by Vega Water, which is engaged by Federation Square to implement its cooling tower risk- management plan.

This system helps Federation Square minimise the risks associated with maintaining its cooling tower system. It does this by ensuring tower compliance is maintained at all times through automatic records management and fault logging.

The system also has the ability to log key water data, which allows the management team to produce trend and exception reports.

"In any cooling tower water system, it is important to have valuable, useful water data," says Anastasiadis.

"Implementing a system on-site that provides this data has been a great outcome for Federation Square, and enabled us to make informed decisions about our cooling tower water management."

SQUARE SAVINGS

The result of Federation Square's efforts is a significant fall in cooling tower system water consumption.

By increasing the cycles of concentration, water savings of between 15 and 20 per cent have been achieved since 2011, with the systems now consuming between 1–2ML per month, on average.

As well as having engaged SAS Water and Vega Water, Federation Square is also working closely with its mechanical services contractor CFM Air Conditioning to improve the water balance across the system.

According to Anastasiadis, SAS and CFM have conducted a review of the system and found further improvements in the way in which the tower make-up water is being controlled.

Cycles of concentration

The term "cycles of concentration" refers to the ratio of impurities or the total dissolved solids (TDS) in the circulating water to the TDS in the make-up water.

The selection of an appropriate level of cycles of concentration is a complex process, so operators and water treatment services providers (WTSPs) need to adopt a holistic approach to these considerations.

The upper limit to the number of cycles of concentration that can be achieved is primarily determined by the purity of the make-up water.

By increasing the cycles, this reduces the bleed and thereby the amount of make-up water required by the system.

But the water savings achievable from the manipulation of the cycles of concentration are not endless.

Typically, the magnitude of the water savings achievable diminishes with rising cycles of concentration values – generally being largest at a value of about 6 or 7, before diminishing dramatically after rising above 10.

Your WTSP should be consulted for the maximum allowable cycles of concentration that can be achieved against the water supply quality.

More information

This information has been adapted from AIRAH's Water Conservation in Cooling Towers Best Practice Guidelines document, which is available free online.

For more information, visit the My Cooling Tower website at www.mycoolingtower.com.au, where the Best Practice Guidelines, case studies and water calculator are all available free.

Additionally, AIRAH's comprehensive DA17 Cooling Towers technical manual can be purchased online at www.airah.org.au

These improvements alone have driven a reduction in cooling tower water losses of 10 per cent.

Combined with other water conservation strategies, such savings will see Federation Square reduce its overall water use to about 4ML per month, and meet a site-wide target reduction of a 26 per cent.

In addition, rainwater harvesting and storage is contributing up to 1.5ML to be used across the site each month.

Anastasiadis says Federation Square is now completing further reviews of the cooling tower system's cycles of concentration, with a view to implementing more improvements.

"From there, we will continue to engage with our service providers to ensure that the system continues to perform in accordance with the expected outcomes," he says.

Federation Square is also keen to seek further opportunities, such as the treatment and reuse of bleed water by reverse osmosis.

"It is our intention to review the options and possible uses for cooling tower overflow water," Anastasiadis says, "as well as look at uses for the basin water when it is emptied during the regular cooling tower cleaning process." ▲

MORE INFORMATION

Learn more about best practices in cooling tower water management and the experiences at Federation Square by viewing "Maintain your cool" on AIRAH's YouTube channel at www.youtube.com