Benchmarking water use in office buildings

A pilot study looking at water use in Wellington office buildings is a first for New Zealand and is creating benchmarks for local and international comparison.

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Internationally, there are few studies that explore water use in commercial buildings. In New Zealand, no formal information is available on how much water commercial buildings might use for a given purpose.

Office buildings in New Zealand are a large proportion of the total number of commercial buildings, especially in city centres. In larger cities, water metering in these buildings provides a driver for water efficiency and conservation activities, but what is missing is a good understanding of water end-uses and what constitutes good or bad performance.

44 office buildings studied

Over the last year, this research project piloted a method for establishing a set of water performance benchmarks. Forty-four Wellington CBD office buildings were investigated, with the active cooperation and assistance of the building owners, occupants and managers and the Wellington water supply and billing utility.

Performance benchmarks are currently being prepared. Building managers will then be able to compare their water-use performance with other Wellington buildings and with the available international data.

Existing international literature shows that the main water uses are expected to be in domestic facilities, air-conditioning and leakage (see Figure 1). However, for New Zealand, the proportions and absolute amounts are predicted to vary between both buildings and regions.

5+ years of water data analysed

Building warrants of fitness, on display in each building, provided preliminary data and management contact details. Building managers and owners were asked to participate, then 5+ years of water meter readings were obtained and analysed. Together with on-site investigation data (number and types of water-using appliances, including the water meter and cooling equipment), this enabled preliminary performance benchmarks to be established.

Water consumption trends

There are approximately 2,106 commercial metered water connections registered within the Wellington CBD. In Figure 2, the line shows average weekly water use across the year (right-hand scale) for the whole Wellington CBD. Columns show the average weekly water use for the sampled buildings (left-hand scale). The CBD water data was provided on a weekly basis by the supply utility, but the studied buildings only had bimonthly revenue readings, hence the two-monthly averages shown.

The summer months display a trend of higher water consumption. This is probably due to the warmer weather, resulting in an increase in cooling load and/or irrigation. However, during the December/January/February period when the buildings are likely to be either shut or have reduced staff numbers for up to 3 weeks, there is no reduction in water use. This contrasts with the dip in the overall CBD water use. The reasons for this have yet to be explored, but office building water demand may be driven not by the presence or absence of occupants, but by the water-using features of the building itself.

Benchmarking allows comparisons

A benchmarking measure 'normalises' water use with the size and use of the building, which

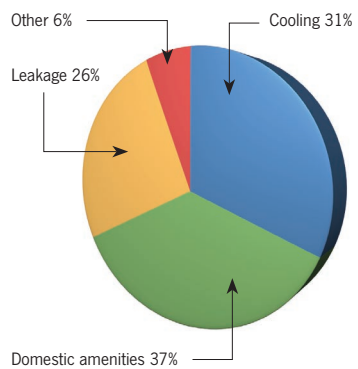

Figure 1: New South Wales example of how purchased water is consumed. (Source: Quinn et al. (2006) *Water efficiency guide: Office and public buildings*, Australian Government.)

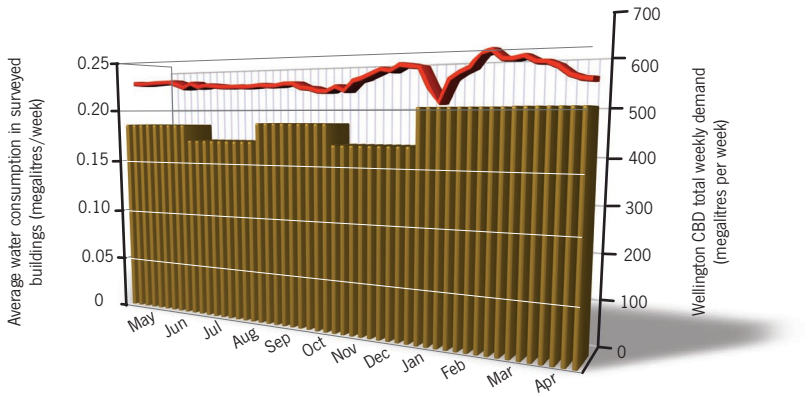

Figure 2: Average water consumption in surveyed buildings from bimonthly readings (column) and Wellington CBD 5-year average total weekly demand (line). (Source: Capacity Ltd.)

then allows comparison with other similar buildings. The normalised consumption model is a measure of water consumption against a driver. The net lettable area proved to be the most statistically and pragmatically appropriate driver, meaning the benchmark figure can be given as cubic metres of water per square metre of net lettable area per year.

The relationship between annual water consumption and the net lettable area of each building is shown in Figure 3. Naturally cooled buildings have been separated from mechanically cooled buildings.

The calculated median water consumption intensity across the entire data set is 1.17 m^3/m^2/year. The best-case consumption benchmark is calculated using the 25th percentile of the data set, or the lower quartile of 0.72 m^3/m^2/year. The excessive use consumption benchmark uses the 75th percentile, or the upper quartile of 1.39 m^3/m^2/year (see Figure 4).

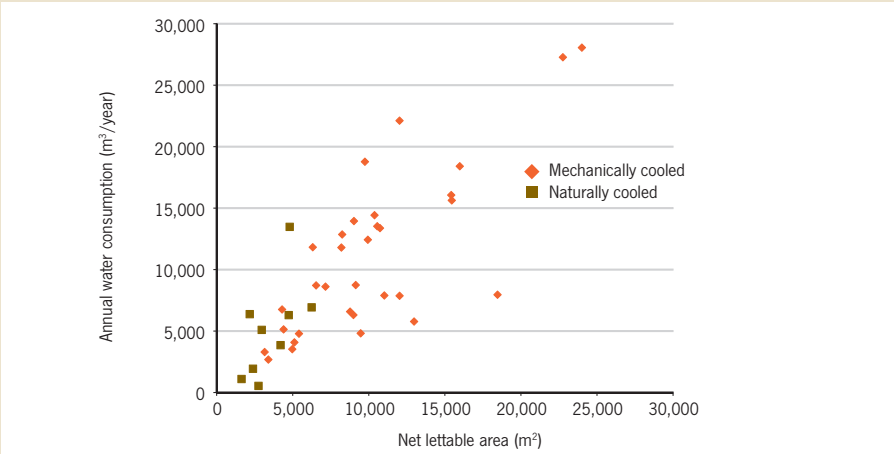

Figure 3: Water consumption (m^3/year) compared with net lettable area (m^2).

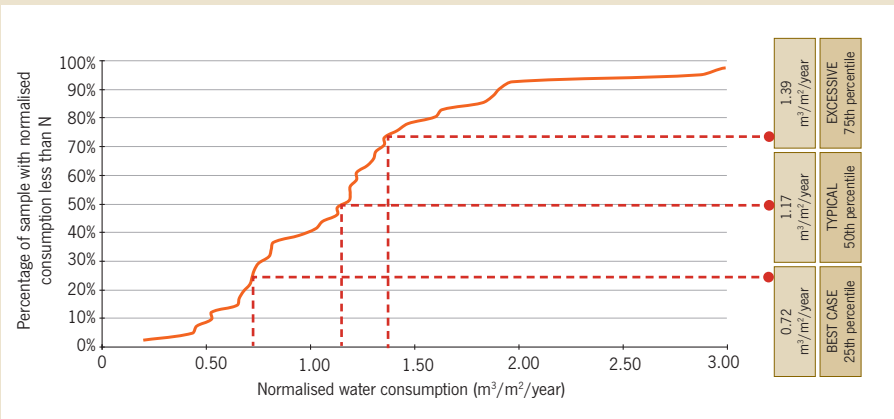

Figure 4: Cumulative distribution of normalised water consumption in the studied buildings.

International comparisons

Internationally, little work has been published on water consumption and water performance benchmarking. In the few existing studies, the rating band percentiles are not always displayed or are unclear. Therefore, only the typical values can be accurately compared as the 50th percentile of the data set.

Figure 5 shows that, on average, the selected Wellington CBD office buildings are performing better than American and on par with Australian buildings. However, the United Kingdom examples appear to be much more water efficient than any other region studied to date.

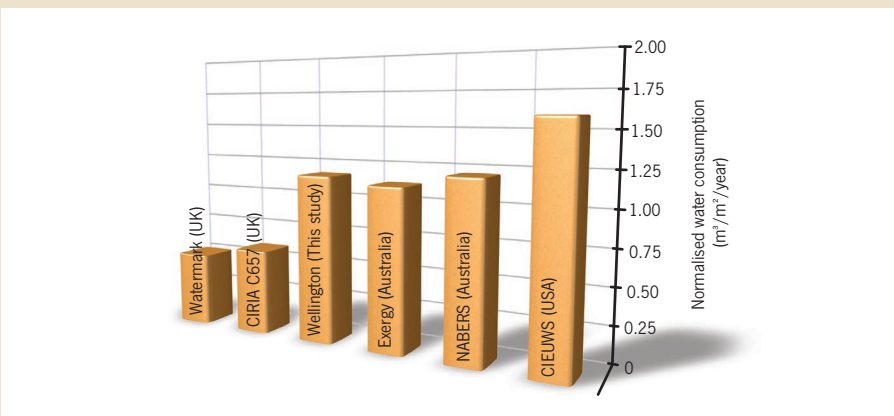

Figure 5: Typical water performance benchmarks from international studies.

Further issues to be explored

This study of office buildings has identified other issues, including:

- 67% of urinals operate on a cyclic flushing system, rather than using sensor or manually activated flushing
- 67% of toilet cisterns are single, not dual flush
- 59% of water meters appeared to have failed within the past 5 years.

In some cases, more than one building was connected to a single water meter, making it difficult to establish how much water each building used.

Water-use database planned

This pilot study targeted selected Wellington office buildings only. Investigation of more buildings in both Wellington and Auckland will enhance the confidence of the resultant benchmarks.

The remainder of the PhD study will look deeper into water use, and water efficiency and conservation within office buildings. The research will develop and implement a water-use database and create a water efficiency/conservation tool. This information will raise much-needed awareness and provide benchmarks and strategies for water use in New Zealand office buildings.

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