



SC3: Water Efficiency Study

In June 2004, Smith Carter Architects and Engineers Incorporated opened the doors to their innovative and environmentally advanced corporate headquarters. Situated on a five-acre, pie-shaped lot in Winnipeg's south end, the 50,000 square foot building was an opportunity for Smith Carter to tangibly demonstrate how the built environment can be used to increase communication, enhance productivity, improve employee satisfaction, and raise the profile of the company. The building has received critical acclaim, winning a Governor General's Medal for Architecture in 2006 and achieving LEED® Platinum Certification in May 2009.

Designed as an active 'beta site' or hands on laboratory, SC3 has since provided the interdisciplinary team of architects, engineers, landscape architects and interior designers an opportunity to test materials, study data and interpret results of sustainable building practices for internal use as well as application to a client's project.

So often the potential for rainwater harvesting and grey water reuse is overlooked in locations that have an abundance of fresh water. In Canada, we take our bountiful supply of fresh water for granted. This indifferent attitude has led to a general lack of knowledge about the quantity of water consumed at the workplace. As an active beta site, SC3 provides Smith Carter with the opportunity to study water consumption patterns in order to monitor inconsistencies and draw conclusions for planning purposes. This actual data is used to inform staff, and, in turn, clients, as they evaluate sustainable practices to apply to their own buildings.

The LEED® Reference Guide identifies irrigation and washrooms as the two primary areas for water conservation in an office building. At SC3, no permanent irrigation system was installed as the native landscaping was expected to thrive without the need for regular watering. In the washrooms, waterless urinals, dual flush toilets, and low-flow faucets and showers were installed, along with low consumption dishwashers in the kitchenettes. In total, SC3 was awarded 5 LEED® Credits for water conservation efforts.

A RELEVANT WATER BASELINE

LEED® calculations assist in predicting water use patterns for the sake of defining credit achievement; however, these assumptions are not meant to predict future utility consumption. In the case of SC3, LEED®



SC3 landscaping includes native grasses and other low-maintenance plantings which are intended to require no irrigation after they are fully established.

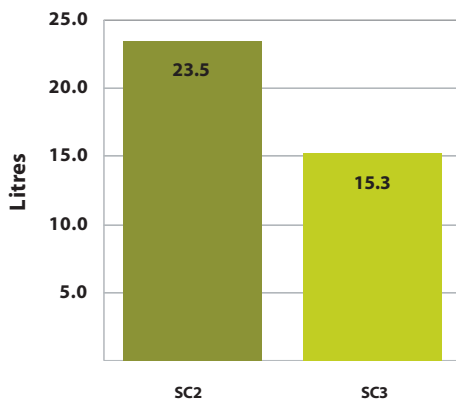


FIGURE 1: Personal water consumption comparison. Litres per employee per day.

predictions are equivalent to approximately 50% of actual annual water usage. For this reason, credit-defined water reduction estimates are not a good indicator of actual water consumption. The LEED® calculator for Water Efficiency Credit #3 does not consider water use for irrigation and cleaning and is limited in its ability to accurately describe kitchen use. Further, the calculations are meant for illustrative purposes only, and may not necessarily reflect the behavior of the actual building occupants. A more appropriate baseline comparison is operational data from Smith Carter's former office, SC2.

Smith Carter's move from SC2 to SC3 provided an opportunity to evaluate new equipment against a relevant and established baseline in order to quantify conservation success. Operating hours and occupant behavior in the two buildings can be assumed to be similar, leaving technology and design as the variables that impact the study. The changes in technology and design have resulted in a 35% reduction in water use per employee, compared to operations at SC2, as seen in figure 1 above.

QUANTIFYING SUSTAINABLE LANDSCAPE DESIGN

Unlike SC3, Smith Carter's previous office was surrounded with non-native grasses which required regular watering to ensure that they stayed lush and green during dry spells. Alternatively, SC3 landscaping includes native grasses and other low-maintenance plantings which are intended to require no irrigation after they are fully established.

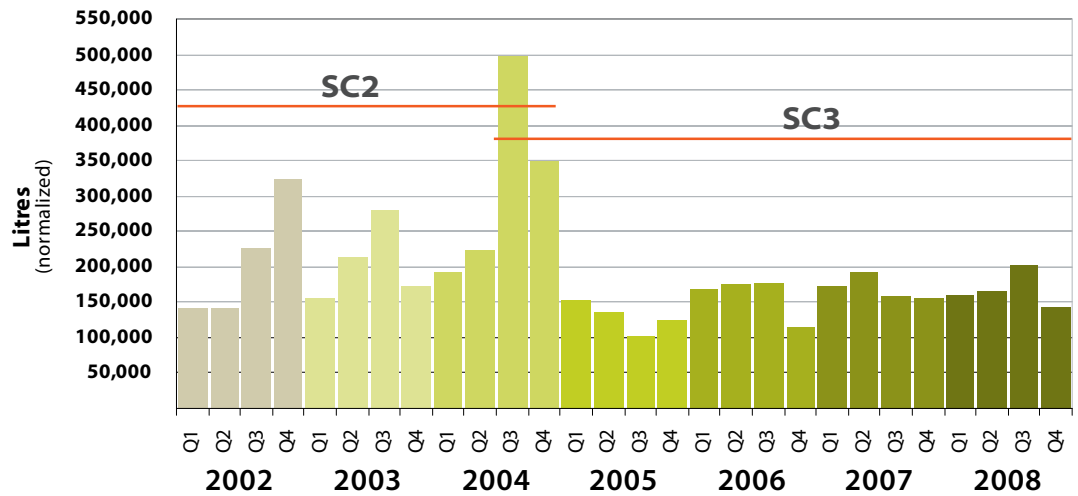
As a beta site, SC3 has experimented with a number of different native plant species in the surrounding landscape. As each new species is planted, some manual watering is done on a regular basis in order to aid in establishment. Nonetheless, the reduction in water use for outdoor watering is clearly apparent when examining quarterly water bills (Figure 2). At SC2, an obvious increase in consumption is evident for Quarter 3 (June, July, and August) when the majority of outdoor watering is required. This same pattern is not consistently shown at SC3, suggesting that although the landscape using native plantings may not have eliminated outdoor watering yet, it has significantly limited the volume of water irrigation compared to the baseline.

QUANTIFYING SUSTAINABLE TECHNOLOGIES

In 2003, at the time of construction, water-saving technologies such as waterless urinals and dual-flush toilets were relatively new to the marketplace, however, Smith Carter was committed to reducing consumption despite the cost premiums and proceeded with the installation of these up-and-coming technologies. These types of fixtures have since become the norm for new projects concerned with water conservation, consequently, the cost premiums have decreased substantially.

It is interesting to note that leading edge technology does not necessarily translate to high performance, and although water savings were evident early on, some of the fixtures were not satisfactory. Experimentation

FIGURE 2: SC2 and SC3
Quarterly water consumption.



with some early generation dual flush toilets may have failed, but important information was gathered to inform future decisions. Since then, technology has advanced, and the majority of the original dual flush toilets have now been replaced with new superior performance fixtures.

Recent examinations of actual water use patterns have determined that SC3 has reduced water use by approximately 42% in comparison to traditional washroom and kitchen fixtures.*

SAVINGS ARE PROPORTIONAL TO USE

It was expected that water usage would increase proportionally with an increase in the number of staff and a rise in water utility rates. As fixture use correlates directly with the number of building occupants, the business case for choosing more efficient water consuming equipment gets stronger as utility rates rise and occupant density increases.

Smith Carter has seen a steady increase in staff from 2002 to the present, resulting in almost twice as many staff regularly working at the Winnipeg Head Office. Due to water conservation efforts, an equivalent increase in water use has not been realized. In fact, total water use for year 2008 remains lower

than use at SC2, despite the significant rise in employees, as shown below.

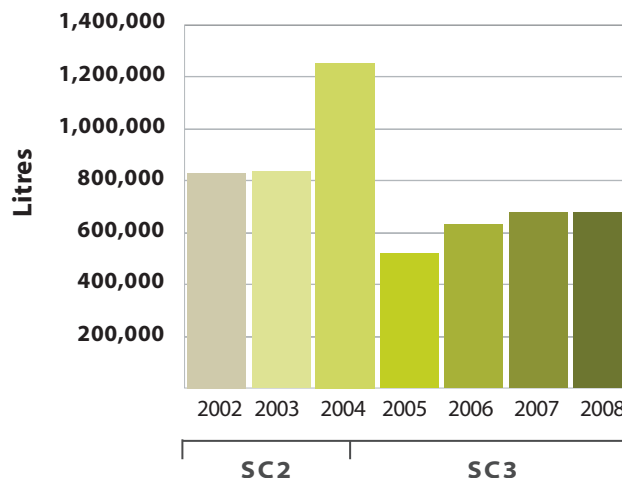
LIVING IN A GREEN BUILDING INFLUENCES INDIVIDUAL AND CORPORATE BEHAVIOURS

Not only have large scale measurement and verification studies helped to increase employee and corporate awareness, but the constant exposure to sustainable practice that occurs naturally by working in the building has caused changes in behaviour across the board. Anecdotally, staff have confirmed that their awareness of environmental issues like

water use has increased and consequently they have begun to make changes in their personal or private lives, conserving water through changing out plumbing fixtures and landscaping their homes in a more environmentally responsible manner.

Corporately, although water dispensers were installed in the building originally, bottled water was still used in meeting rooms and for visitor consumption. In an effort to ensure continued corporate leadership, an additional reverse osmosis dispenser was installed and pitchers of water and glassware are now

FIGURE 3: Yearly water consumption



* For the purpose of this study, traditional fixtures were defined as 6.0 LPF toilets, 3.8 LPF urinals, 9.5LPM faucets@10sec/use, 9.5LPM showers@5min/use, and 35L per load dishwasher. Savings are, however, only 34% when a penalty for using reverse osmosis for drinking water is considered.

provided in all meeting rooms. Bottled water is no longer purchased eliminating the need for 3800 plastic bottles per year. As an additional benefit, Smith Carter has realized an annual savings of \$1500 / year (after proportionate equipment costs and an increase in utility bills have been factored).

RESULTS ARE MORE IMPORTANT THAN CREDITS

As a beta test site, Smith Carter has had the opportunity to use SC3 to test equipment, strategies, and assumptions as the building has evolved to meet the needs of a growing workforce. One initiative geared to increase a sustainable way of thinking around water use in the workplace is a Measurement and Verification Water Survey which was implemented at SC3, to quantify water use at the workplace. Results from the survey will help employees understand how both occupant behavior and the technologies that are specified during design can impact both water demands and savings.

Actual water consumption cannot be directly compared with expectations formed during the LEED® submission; however, an adjusted baseline which is inclusive of all water uses can be used in a similar way to predict a more realistic usage profile. With actual occupant behavior and working conditions documented, along with an account of historical water bills, a baseline of water use was created (as seen in Figure 4).

Over a one week period, water consumption was monitored intensively at SC3 with all employees recording their daily behaviors. A relative count of fixture use helped to develop a user preference matrix which explains actual fixture use over this period. It was discovered that, although the number of employees at SC3 has grown since the LEED® submission, the total number of fixture uses was well below that estimated for the submission. Employee out-of-office travel and full-hour

FIGURE 4: Water use in base case.
Using LEED® assumptions for occupant patterns, but including all uses not considered by LEED®, 34% savings is predicted.

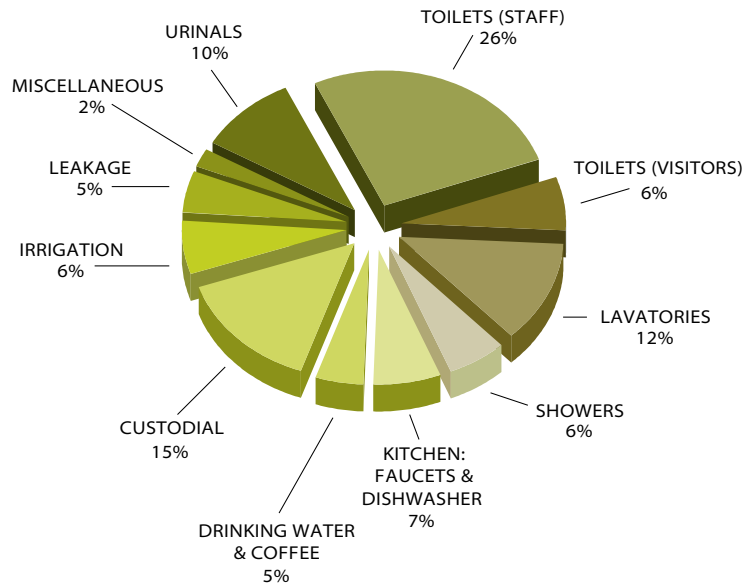
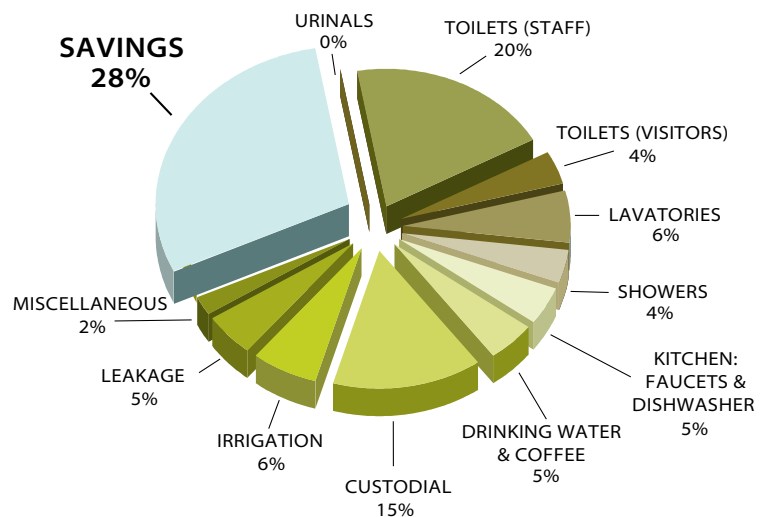


FIGURE 5: Water use in design case.
Expected Savings.



lunch breaks, where many employees leave the facility, may help explain why washroom facilities are used less than the typical 3-times per person per day.

When weekend use and overtime are factored in, the adjusted design case shows water use within 15% of that estimated during design.

This measurement and verification effort illustrates that the primary reasons for lower savings than expected are:

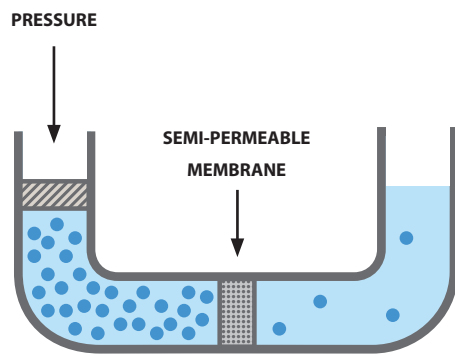
- 1) Lower overall washroom uses per person;
- 2) Technology overlap: conservation potential of dual flush toilets is underutilized where waterless urinals are equally available.

Results from the study are still under consideration and are expected to inform the next steps in experimentation at the SC3 Beta site. Meanwhile, the valuable knowledge that Smith Carter has gained from this study will be referenced for all future design projects.

10 LESSONS LEARNED

- 1 Occupant behavior is the most significant factor affecting water use.
- 2 Educating users on proper use of water saving technologies is key to influencing behavior.
- 3 Sharing the results of conservation efforts with employees will provide encouragement and may engage an understanding of how to extend these efforts at home.
- 4 Equipment that is used most intensively provides the greatest opportunity for savings.
- 5 'Native plants' may be technically suited for the site, but they will not thrive without good soil conditions, regular watering, and pest-control during establishment.
- 6 Experiment with leading edge-technology, but be prepared for unexpected results.
- 7 Any fixture with sub-standard performance will likely result in mis-use and frequent complaints, regardless of its rated conservation performance.
- 8 Water leakage occurs even in relatively new buildings. It is important to detect and repair leaks on a regular basis.
- 9 Reverse osmosis (see figure 6) drinking water systems waste a lot of water and eliminate good elements such as fluoride during water purification.
- 10 The LEED® Letter Template Calculator is not a good predictor of future water purchases.

FIGURE 6: Reverse Osmosis.



REVERSE OSMOSIS is one method of water purification used for medical and scientific purposes, and for purifying drinking water, as is the case at SC3. The process starts with a filter trap and carbon filter to remove larger particles such as rust and chlorine, and then uses pressure to force the filtered water through a semi-permeable membrane which removes all other small particles and minerals. This process produces 2 to 3 litres of waste water (or more) for every 1 litre of purified water, depending on the water pressure in the building.

Quantifying the volume of water used by these devices has caused Smith Carter to evaluate the need for such a high level of water purification. An investigation about the options for disconnecting the R.O. section of the water filter, closing the direct line to the sewer, and operating through the carbon filter only is currently ongoing. Once complete, these changes are expected to reduce water use, and arguably improve the quality of the drinking water, allowing elements such as fluoride to remain in the water.

ABOUT THE AUTHOR

Sarah Chernis is the Sustainability Coordinator for Smith Carter in Winnipeg. She has a Bachelor Degree in Environmental Design from the University of Manitoba and has a passion for sharing her knowledge about efficiency and sustainable design. She is an experienced LEED® Coordinator and energy modeler and has performed energy and water audits for commercial buildings across Western Canada.