

# SMART WATER METERING

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## Abstract

It is surprising to see how much confusion, misinformation and myth exists around 'smart water meters' when the reality is so simple. This paper attempts to demystify smart water metering by defining what a smart water meter is and how it works. It discusses the role of smart water meters in obtaining valuable water usage data. An overview is given of the technology which is utilised in smart metering and the set ups currently used. The paper emphasises the benefits and value of smart water meter data for large users through several case studies and examples.

## Introduction

Conserving water is becoming increasingly important in Australia as the country faces a widening gap between ever reducing water supplies due to climate change and increased demand from population growth. Water conservation means using less water as well as using alternate sources of water. Water conservation now goes well beyond flow restricting taps and showers and optimising toilet and urinal flushing. Today's integrated programs comprise the use of water efficient appliances and technologies such as waterless urinals and electronic taps. Smart irrigation application and control systems achieve far better water utilisation. Optimising water intense processes and cooling tower operation yields significant improvements. Automatic leak detection and monitoring systems permit to identify and then fix leaks, and even cut off the flow. Rainwater harvesting, greywater and black water recycling schemes are used to replace potable water. Education heightens user awareness. Incentives (rebates) and tighter regulation are yet another component.

However, prior to undertaking such steps, it is vital to understand how, when and why water is used.

## What is a Smart Water Meter?

A Smart Water Meter is a normal water meter linked to a device that allows continuous electronic reading and display of the water consumption. It negates the



Figure 1. Typical Smart Water Meter Set-up.

need to manually read the meter dial. Once this information is available as an electronic signal, it can be captured, logged and processed like any other signal. Mobile phone technology, wireless modems, the internet and other data distribution technologies make it possible to bring this signal readily to a computer. Hence a Smart Water Meter can also be labelled a "water meter on your desktop" as shown in Figure 1. Readings are typically taken every 15 min, even though most systems allow for far more frequent readings. Yet, in most cases this is found unnecessary, simply leading to an unnecessary flood of data rather than additional information.

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## Who Should Get a Smart Water Meter?

A smart water meter can be set up at any application be it small or large, domestic, residential, commercial, institutional or industrial. Obviously, the larger the water consumption measured, the better the economies of scale. The cost of a smart water meter is independent of the size of the meter it monitors. It makes it hard to

justify its cost in domestic applications, especially with current water prices and even more so when the sewerage charges are fixed instead of being variable.

Many water authorities experiment with smart water meters for their residential customers, largely to better understand consumption patterns. It is hard to see how this could become main stream within the next few years due to the lack of economic incentives for this group, and because manually reading the water meters is still cheaper.

The situation is completely different for large water users, though. As shown in this paper, for them smart metering their water consumption will soon become the norm rather than the exception.

## Why Smart Water Meters?

What you don't measure you can't manage. A smart water meter shows the water consumption in real time. It can generate alarms for excessive use. It identifies abnormalities as they occur so that a facility manager can take action to conserve precious and increasingly expensive water. It helps to understand water consumption at a site – and derive corresponding water saving actions from it. In turn, it improves decision making and optimum allocation of capital. Expected savings are based on data, rather than guess work. Smart Water Meters provide the robust platform upon which any integrated water management system should be built.

The recently launched NABERS OFFICE Water (National Australian Built Environment Rating Scheme for water consumption in offices) will add further support for smart water metering. Offices are rated from one to five stars depending on their water efficiency. Smart metering will facilitate benchmarking and reporting under the scheme while ensuring that a star rating once achieved can be sustained. One simple leak not detected for a few months could void all the hard work and make a building lose its NABERS rating. Anecdotes abound where it took literally

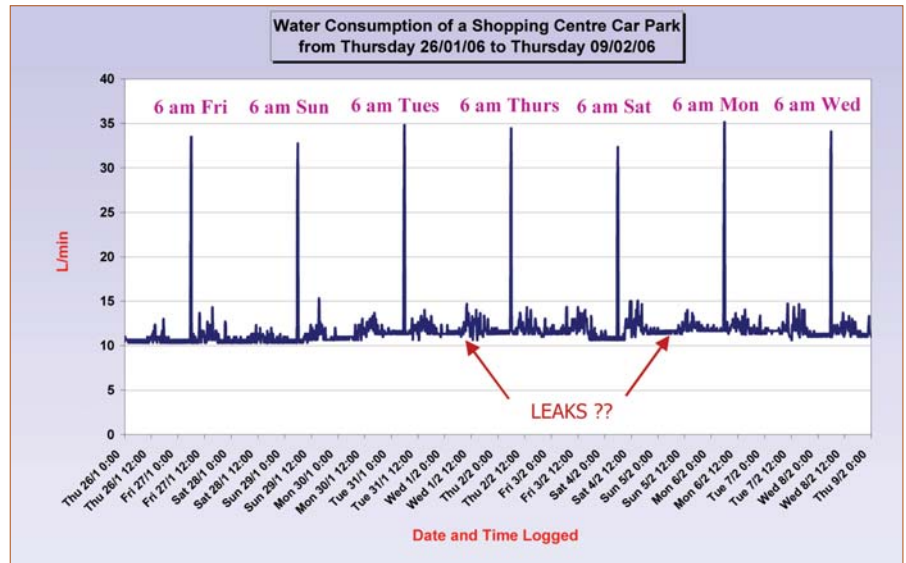
years until blatant water wastage was stopped. Normally quarterly water usage bills are issued and this is the only data point that exists. Even if monthly bills are issued they are often derived from quarterly readings. Hence, a whole year's worth of water consumption is described in nothing but four data points. There is nothing else. No further information is available to draw upon should there be any queries. The case studies below illustrate this point.

**CASE STUDY 1:** Typical of other investigations, it all began with an abnormally high water bill. Since water bills were not passed on to the end user, the accounting department looked at the invoice, noted that it was higher than usual but then paid it since all other invoice details were correct. Payment was accompanied with the hope that the next bill would be back to normal and that the problem would resolve itself. Yet, three months later another high water bill arrived. Some questions were raised, but still no serious action was taken.

It took a third expensive water bill until someone finally decided to do something about it. Upon closer inspection, a wet patch near the embankment of a sports facility was found. However, the facility manager was adamant that there were no leaks. "It must be an underground spring", was the explanation tendered. When the problem still hadn't gone away after the fourth bill, an entire year later, a more thorough investigation was commenced. One night, all internal isolation valves were turned off. It identified that indeed there was a large underground leak right after the main meter.

**CASE STUDY 2:** In another case a car park with no car wash facility or extensive cleaning consumed almost 2,000 kL of water per quarter. After four weeks of smart meter monitoring, it was evident that there was a significant leak of 10 L/min which occurred constantly throughout day and night. In addition, every morning at 6am the next door neighbour was drawing some "free" water for illegal irrigation of his landscaping. Figure 2 shows the smart metered water consumption pattern for this car park.

**CASE STUDY 3:** During the first week of a three week smart water metering period, a toilet block was found to have a base flow close to zero at night, when nobody was in the building. However, during the second week of monitoring, the base flow overnight increased to 8 L/min. This base flow increased again in the third week of monitoring to 16 L/min. The flow pattern of this toilet block is shown in Figure 3. Upon investigation it was found that the



**Figure 2.** Water consumption of a car park recorded every 15 minutes (from Smart Water Meter data).

increase was due to first one, then two leaking cisterns. If this had gone unreported for a whole year, water wastage would have amounted to around 8,000 kL or over \$18,000.

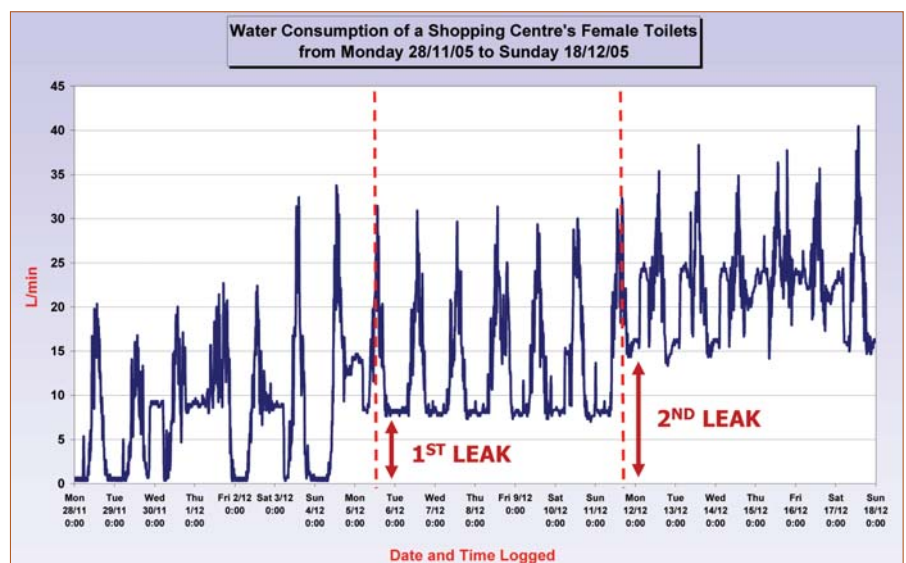
### What if Water is Paid for by the Tenants?

At large offices, retail centres and multi dwelling properties the water bill is often paid for by the property manager. Costs are then distributed across the end users as "outgoings". Hence, some property owners believe that the cost of water does not matter as it is simply passed on. On the same note, since the end users pay for water as outgoings and not per kilolitre of water consumed, they do not have a clear driver to reduce their consumption. Hence, there

is a lack of incentives for either party to save water.

However, this should be looked upon as every dollar wasted is an opportunity to save a dollar. It is then simply up to the creativity of a property manager how this can be turned into a win-win situation. In the words of one manager "if we save a tenant \$5,000 off their water bills, if nothing else, it increases their capacity to pay rent", not to speak of improved tenant retention and better relationships.

As water is getting more scarce and expensive, the government and the community expect large water users to manage this precious resource as diligently as they are expected to monitor other critical parameters of their operations such as e.g. building temperature, ventilation or



**Figure 3.** Water consumption of a toilet block recorded every 15 minutes (from Smart Water Meter data).

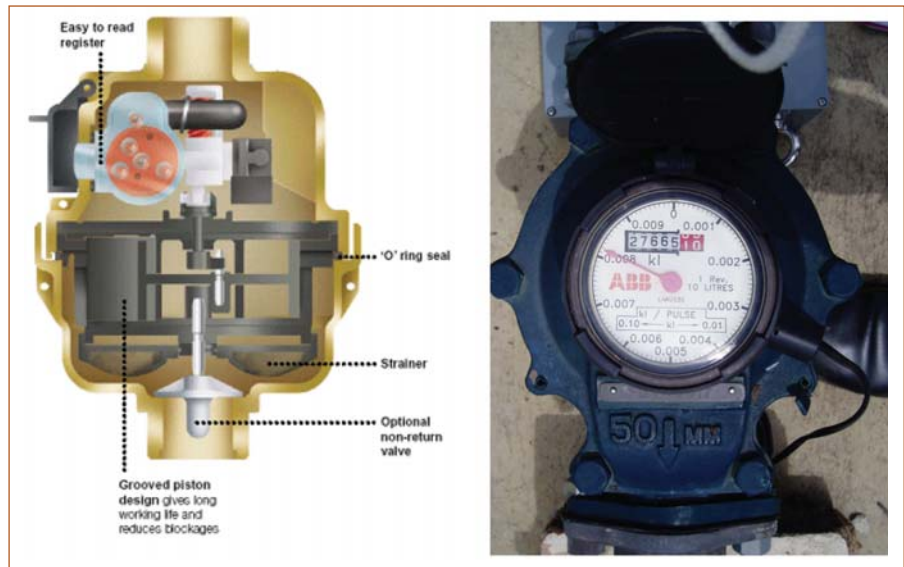
electricity. Adding water consumption to the suite of electronic data that is already collected will barely budget as additional expense under this budget item, especially when considering how simply this can be done as explained in this paper.

## How Can I get a Smart Water Meter?

All conventional water meters have a mechanical device inside that turns in proportion to the volume of water passing through. In addition, most modern water meters are smart enabled, meaning they have a small hole (usually covered by a rubber cap) or a jacket where a probe can be inserted or attached that picks up a magnetic pulse every time the wheel turns (Figure 4). The probe can readily and separately be purchased from the meter manufacturer (Elster, Davies-Shephard, ABB, Kent, etc).

When ordering the probe it is important to know the exact type of meter which is often impossible to find out unless one rings the corresponding water utility with the exact meter number. Alternatively, one can measure the length of the meter from end to end and its connection diameter (using a calliper, as it is surprisingly hard to estimate whether it is e.g. a 40mm or a 50mm meter!). In addition, the exact type of fitting (flanged [round or oval] or screw connection) should be described. A photo (use your mobile if you can) can be an invaluable lifeline. If all fails and the wrong pulse probe is obtained, simply return it and swap it for the right one. Pulse probes are inexpensive. Usually they cost anywhere from \$30 to \$50 with few probes costing more than \$100.

Once the probe (effectively a reed switch) is inserted into the water meter it picks up each turn of the wheel as an electric signal. Thereafter, it is a relatively standard process to capture and store this data and turn it into useful information as explained above. The only other essential information required is to know the volume of water that one pulse (one turn of the wheel) represents. Normal values are 1 litre/pulse, 5 litres/pulse or 100 litres/pulse, but it depends on the size of the water meter. If a water meter is an older model and is not pulse enabled (i.e. it does not have a probe hole or a probe jacket), and there are no other methods to attach a pulse output device, one could install a new more modern smart enabled water meter downstream of the authority billing meter. However, the far better option is to call the water authority and request a meter replacement. Chances are they are happy to do so free of charge as most water



**Figure 4.** Cut away section of a typical water meter and photo of a physical meter (note pulse probe attached in 4 o'clock position).

authorities aim to replace their water meters every ten years as they lose accuracy, turn slower and thus let the water authority's cash register ring less often.

## Options for Data Collection and Distribution

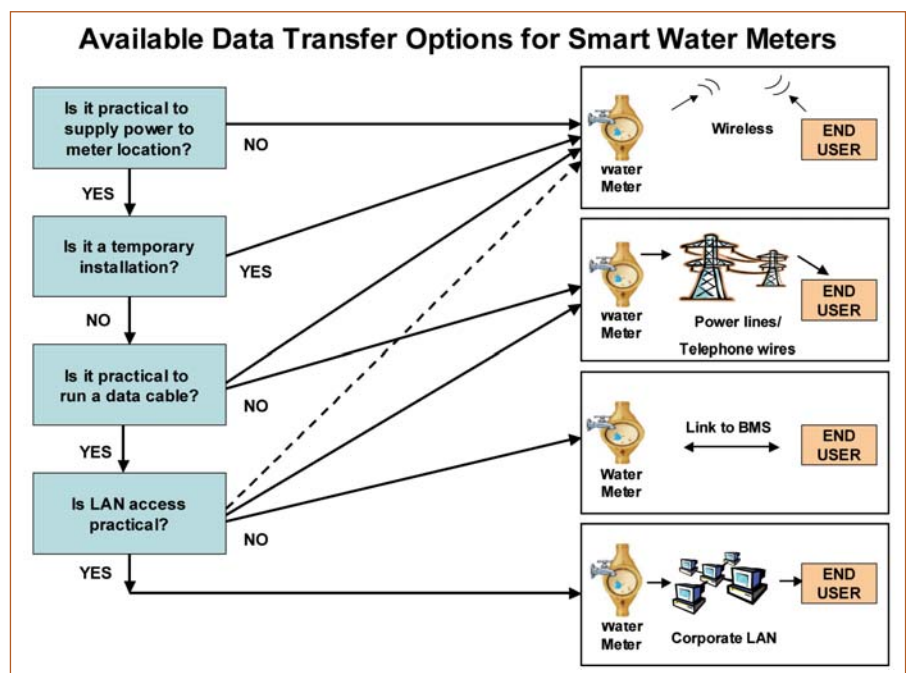
The pulses generated are recorded and time stamped by a data logger. There are then several methods how this recorded water consumption data can be collected and communicated to the end user.

The two fundamental options are:

The older style data logger, where data stays in the box until a technician comes and downloads it. This has the disadvantage

that no water consumption data is available until the download has happened. If the meter or logger fails the day after it was installed, it will take until the next visit when it is noticed that four weeks worth of monitoring time have just been lost.

The more modern systems relay their information directly to the web, or at least to a central server using wireless modems, dial up links, secure connections via a company's LAN or ripple technology to send the signal via electrical wires. Feeding the meter via a direct cable connection into the existing Building Management System is another option. However, it can involve expensive cable runs. Where feasible,



**Figure 5.** Options to convey smart meter data from the field to a computer near you.

mounting another meter nearer the electrical or data connection point can overcome that, but it can also be costly and it leaves part of the system unmonitored.

Depending on the site, application and ease of installation, the different options for data distribution are summarised in Figure 5.

The fact that water meters are often out in the street, not secure, exposed to the weather and without a readily accessible power point or data connection presents an extra challenge (Figure 6). Generally, lower capital costs for installation are accompanied by higher costs for running the system, and vice versa. Hence, in the past short term monitoring campaigns were normally done by standalone loggers. However, the rapid fall in costs for wireless modems and communications have quickly absorbed the cost of a service technician to go out to site every time a data download is needed. In fact, in certain scenarios, even permanent installations can now be done cost effectively via wireless technology.

Some boxes are now available such as the "ECS Smart Water Meter" that can perform this task with a built in battery charged via a small solar panel connected to it. Alternatively, if supplied with a double battery pack the unit, which has a special sleep mode, can last up to three months without re-charge, or it can be hooked up to a permanent power supply.

Sydney Water through NSW Department of Commerce use Manly Hydraulics for a standalone data logger. It stays near the meter and records the water consumption data until a technician goes to site to download it. Later models have an uplink capacity as well. WaterSave have adjusted their automatic WaterGuard leak detection and flow isolation device so that it can also act as a smart meter. It can connect to a company's computer network by opening a secure port, or it can communicate via a wireless modem. Others such as EP&T, Intermoco or Metering Dynamics provide similar services either via web sites, e-mail servers or the BMS.

Relaying the data via dedicated web sites provides additional functionality. Some sites like iMonitorData now even include sophisticated absolute, relative and rule based alarm and exception reporting. Alarms can be set depending on the time of the day and whether it is a weekday, a



**Figure 6.** Example of a field installation of a standalone smart water meter.

weekend, public holiday or a school holiday. These servers allow sending out automatic priority based notifications via voice mail, SMS, fax, email or via a dedicated web site complete with a historic log. Adding the action taken to address an alarm rounds off a complete active water

## UPCOMING EVENTS

*Global Smart Metering Technology Summit 2006: Understanding the New Opportunities For Managing Demand Using Next Generation Domestic Metering Technologies, (29-30 June 2006, Hotel Russell, Russell Square, London, UK*

Today, global water companies require new solutions for curbing demand as pressures on resources intensify. The next generation of intelligent metering technologies offer many attractive advantages but "can smart metering technologies deliver the benefits, *at the right price?*"

After consultation with the international water industry, London Business Conferences are pleased to host the first annual Smart Metering Technology Summit. This summit will help you gain a thorough understanding of the latest domestic metering technologies in the market place, in terms of the associated total benefits and costs.

conservation management system. It enables users to detect and respond to abnormal flows resulting from breakage, misuse, vandalism or changes in demand almost immediately without paying for months of wasted water.

## Conclusion

Smart metering of water consumption is no wizardry. If done correctly it is simple, robust and inexpensive. It can provide more than just usage data for water consumption issues. It is a powerful tool to support an integrated water conservation management system to achieve sustained water savings. By actively monitoring the water consumption the asset manager can readily intervene as soon as an exception alarm is raised. Understanding where, when and why what water is consumed helps to identify further water conservation opportunities and assists in achieving realistic savings. Leaks, going unnoticed for months on end, will become a thing of the past.

The advantages of smart metering are so obvious. It will not be long before we wonder how we could ever have attempted to manage water consumption without smart water metering!

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