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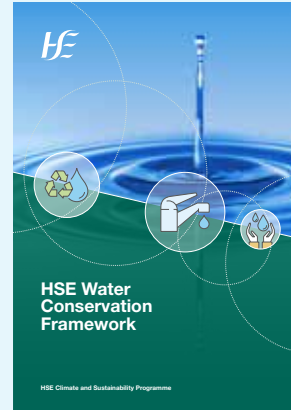
Sub-metering of water in Irish hospitals

**A best practice guide to water
sub-metering programmes in
Irish hospitals to improve water
efficiency, save carbon,
and reduce costs.**





Water conservation is now a key element to the HSE’s Climate Action Strategy 2023-2050 and also addresses a number of the Sustainable Development Goals (SDGs) that Ireland has signed up to.



HSE strategic approach to water metering

The accurate and regular measurement of water consumption data is fundamental to the HSE’s Water Strategy Framework.

However, with over 2,000 locations around the country, the Capital and Estates Sustainable Infrastructure Office is working through a strategic approach that combines live data monitoring for the largest hospitals with regular bill analysis for the smaller sites.

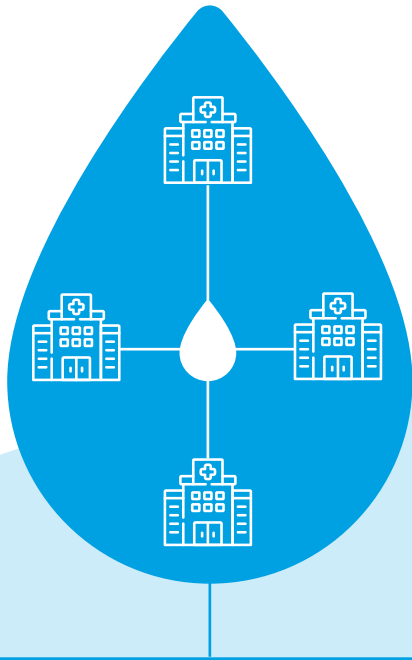
Currently, the HSE fund online mains water meter monitoring systems (using the Epi-Sensor platform) for hospitals with significant water consumption (i.e. those using over 20,000 m³ a year that fall into Uisce Eireann’s Band 3 or 4) and those have completed the Water Stewardship programme.

For any site installing online water monitoring of mains water meters and internal sub-meters must ensure that the system is compatible with IBM Envizi which monitors HSE water consumption on a hospital, regional and national basis.

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Water - an essential resource for the healthcare sector



Water is an essential resource for the operation of all healthcare services. Nationally, the Health Service Executive (HSE) is the biggest customer of Uisce Éireann (UE), spending an estimated **€16 million** a year on water and wastewater services.

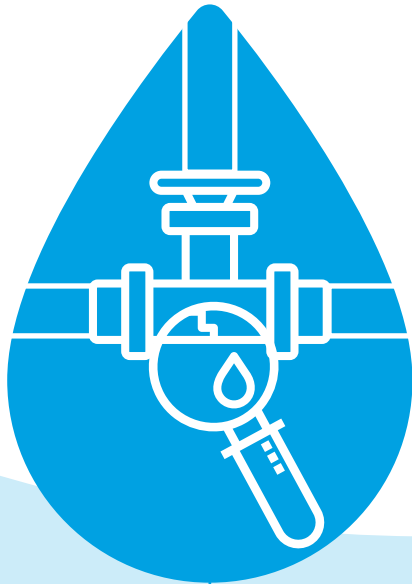


Operating in a unique water using environment where water is typically used 24 hours a day, 365 days a year, the healthcare sector must play a major role in national water conservation measures.



Additionally, at a time where water demand nationally exceeds supply levels, water conservation has never been more important.

Repair - a core element of water conservation



A core element of the HSE's strategy on water conservation is the identification and repair of leaking infrastructure. This is a complicated task in practice.



Much of the water distribution and wastewater discharge infrastructure in healthcare sites has been in place for many decades and includes cast iron, clay and lead pipework.



These are prone to leaks and, as leaks typically occur underground, a comprehensive monitoring system is a crucial tool for on-site maintenance teams to identify and repair leaks.

The importance of on-site water supply monitoring systems

With ongoing technological advances, and the evolution of the Internet of Things (IoT), it has never been easier to put a monitoring system in place for water use across a healthcare site.

These systems provide live data from mains meter(s) and internal sub-meters that can be used to identify existing leaks in real-time and consumption trends over time.

AS EVERY SITE IS DIFFERENT, THERE IS NO ONE-SIZE-FITS-ALL APPROACH.

However, the step by step approach outlined here provides a standard methodology that allows for different delivery solutions depending on site requirements.

Before we start...

From meters that are 'logged' on an IoT based system, data is sent remotely to an online platform that captures the information and displays it in a clear and useful manner. The following are the three main elements of such a system:

THE SUB-METERS

THE I.T. HARDWARE

THE I.T. SOFTWARE



The Sub-Meters

There are a wide variety of sub-meters available on the market. Typically for internal sub-metering within a site a mechanical meter will be sufficient.

Depending on the size of pipe, these meters cost between €500 - €1,000 and there are two main classes to consider - **Types B and C**.

Type B are slightly cheaper and measure through displacement. They are more accurate at low flow rates and best suited to steady flows.

Type C are velocity based meters and are more accurate for higher flow rates. They have less moving parts and are therefore more reliable than Type B.

Type A submeters are typically used in small domestic installations and are not suitable for the accuracy required in commercial settings.

Electromagnetic (mag) meters are also an option. While they can be more expensive, they have become more affordable in recent times (especially for small bore pipe sizes). These are more accurate than Types B & C, though the latter provide adequate accuracy for sub-metering.

Regardless of the sub-meter type, they should all come with a pulse lead which can then be connected to a data recorder (node) that will send the water data to the cloud-based system.

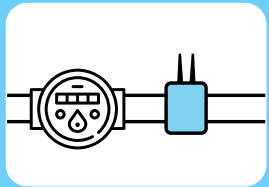
Note: if a new building or function is being built then you should always include a sub-meter during the construction phase.



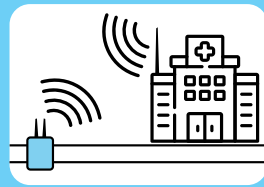
The I.T. Hardware

Water sub-meters can be installed anywhere on the water distribution system depending on site needs.

From the sub-meters, data is sent remotely to an online system that captures the information and displays it in a clear and useful manner. The locations where sub-meters are installed often lack convenient access to mains power so most water sub-metering systems typically rely on the following set up:



Battery operated nodes that are attached to installed sub-meters (more on these later)



These nodes then send data to a central gateway/hub (usually on the roof of an adjacent building and can be mains or solar powered)



This then sends the water consumption related data to a cloud-based system that is accessible online (phone, tablet, PC)



This sub-metering system is independent of on-site IT networks (best for security and ease of deployment)

Node Repair

Due to the often challenging environments where sub-meters are installed (underground, damp conditions), nodes can experience intermittent connectivity issues. However, these are relatively easy and cost effective to replace/repair.

Don't over do it

Remember: there is always an inclination to put in more sub-meters than needed. So, when finalising your plan, always consider these three questions: **What are we measuring? why are we measuring it? and what can be done with the information gathered?**

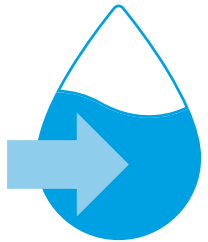


The Software

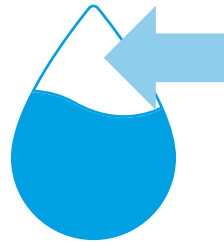
The data collected from the nodes on sub-meters (and the mains meter(s)) is sent remotely to a data management platform where it is represented graphically.

There are various commercial options available, though it is recommended that a system independent of a BMS is used. While BMS are vital for building management, they are not best suited to the easy visualisation required for a good water metering system or allowing data access for external stakeholders (e.g. Regional Sustainability Officers).

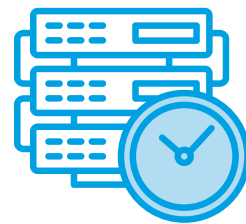
Any data visualisation system should be able to, as a minimum:



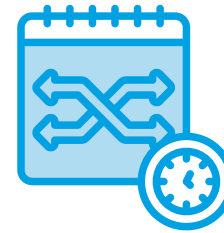
Combine multiple mains meters to give 1 total supply volume



From this and the relevant sub-meters, identify the un-metered volume



Each meter should provide 24-hour data in hourly totals (default) as well as litres/second flow



Provide flexible date and time options



Provide data analysis trend lines from which alarms can be set

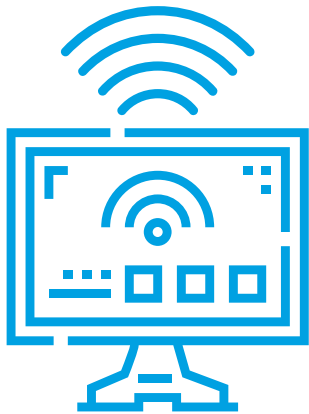
Elements of a sub-metering programme

1. The mains meter(s)



Most sites currently do not have real-time information on water consumption and must rely on reading their mains meter manually or gathering data from bills when they arrive. This limits the ability to detect leaks early, identify abnormal usage, or benchmark overall performance.

For this reason, the first step in any water conservation programme should be to get live data from all relevant mains meter(s) through an online monitoring system.



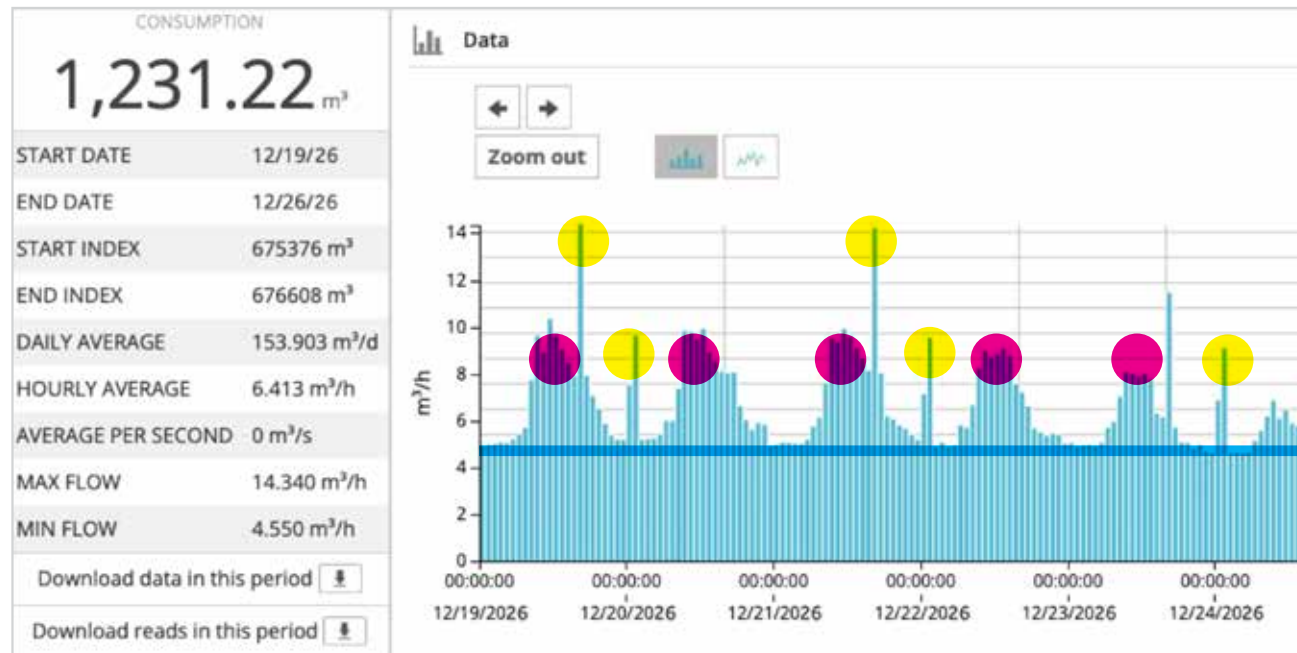
REMEMBER: mains meters are installed and maintained by UE but anything that happens after the mains meter (e.g. leaks) is the responsibility of the healthcare facility.

Many sites have more than one mains meter, which can complicate the monitoring process.

However, each mains meter has a unique Water Point Reference Number (WPRN), so through contacting Uisce Éireann (UE) - or the regional Sustainability Officer (SO) - on-site maintenance teams should be able to identify all active WPRNs for inclusion on the mains monitoring system.



By monitoring the mains meter(s) the overall water consumption of a healthcare site can be assessed. The example below from a mains meter logger shows a weekly profile of water consumption at an Irish healthcare site. Such data helps identify daily and weekly trends, spikes in use and also the background water use which is typically related to background water leaks.



— Background Water Use ● Daily Profiles ● Usage Spikes



Elements of a sub-metering programme

2. Up to date network drawings

All sites will have water network drawings but they may be old or incomplete. As an effective sub-metering plan must be based on a reliable understanding of the main distribution network, developing an updated version is a best practice that all healthcare sites should consider.

It may be possible for the on-site maintenance team to develop up to date network drawings but, in many cases, external contractors are engaged for this. Regardless of who is involved, the following are some of the main things to consider:

A. Compare & collate

Start by collecting all current network drawings and related information from external sources.

This could include:

A	A review of existing drawings and comparing them with older ones	✓
B	Comparison with any local authority site drawings; a lot of the historic pipe upgrades would have happened in collaboration with local authorities when they managed local water services	✓
C	Interviews with on-site staff (past and present) and external contractors that are frequently on-site	✓



B. Develop up-to-date drawings

Based on the data gathered in the previous step, develop an up-to-date network drawing. This should be for the main distribution network rather than the internal pipework within buildings and also include wastewater.

Such a drawing should include:

Existing mains meters



Existing sub meters



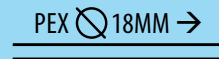
Existing sluice valves



Location of main water distribution pipework



Sizes & material of the pipes



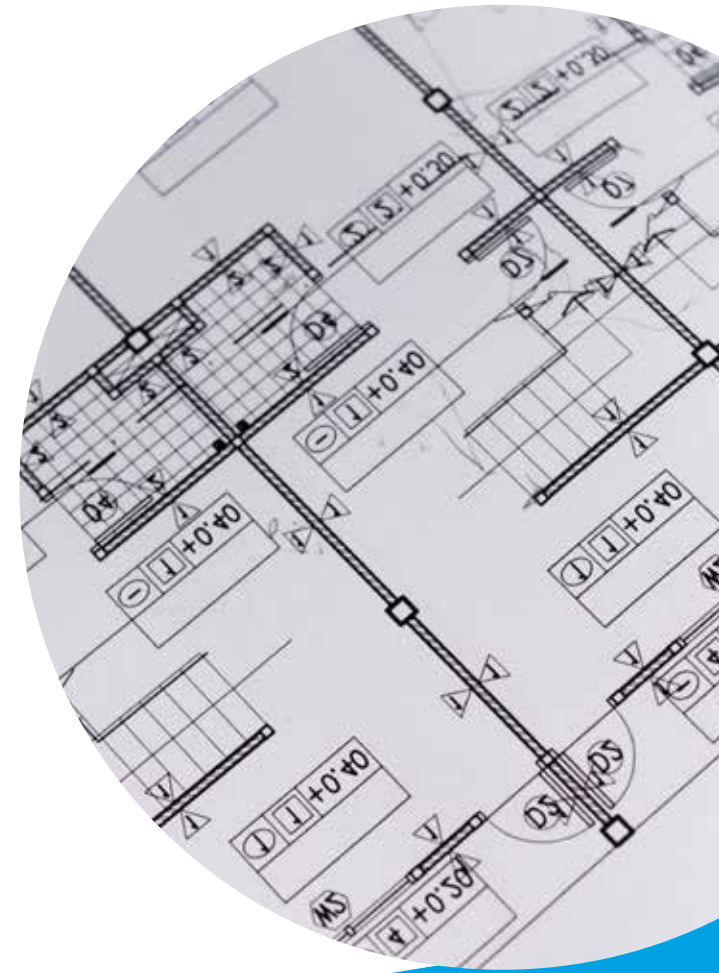
Wastewater pipe



Repairs/upgrades already completed



Fire hydrants (if not on a separate ring main)



Once this new network drawing is completed, ensure that it is reviewed and updated periodically, especially after significant infrastructural or civil works on site.

Elements of a sub-metering programme

3. The Stages of a sub-metering site plan

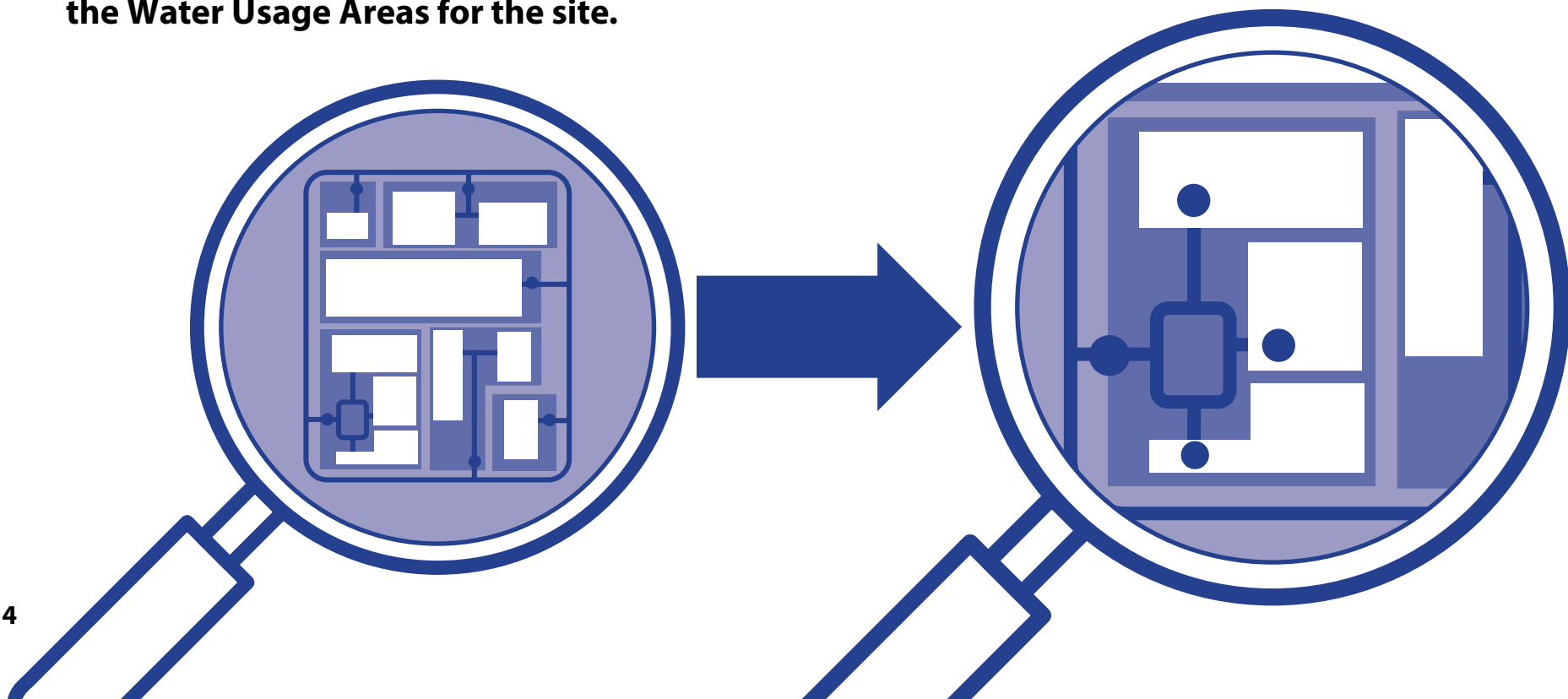
While there is no one-system-suits-all, a good water sub-metering programme is best delivered in a number of **implementation stages**. Below is an example of how a metering plan might be implemented. Remember, this can only be done on the basis of accurate network drawings.

STAGE 1.



Sub-metering the Main Water Distribution Pipework to designate the Water Usage Areas for the site.

STAGE 2.

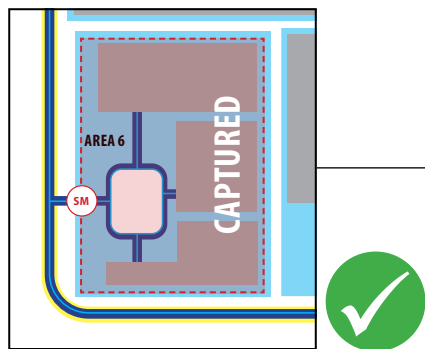
Sub-Meter the Main Buildings/Functions within the Water Usage Areas.



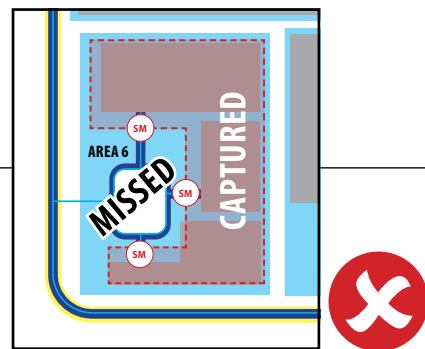
Stage 1. Sub-metering the Main Water Distribution Pipework to designate Water Usage Areas

-  A sub-metering programme should first focus on the **Main Water Distribution Pipework AROUND** the site.
-  The placement of this first set of sub-meters will help sub-divide the site into **Water Usage Areas** that can be monitored separately from each other.

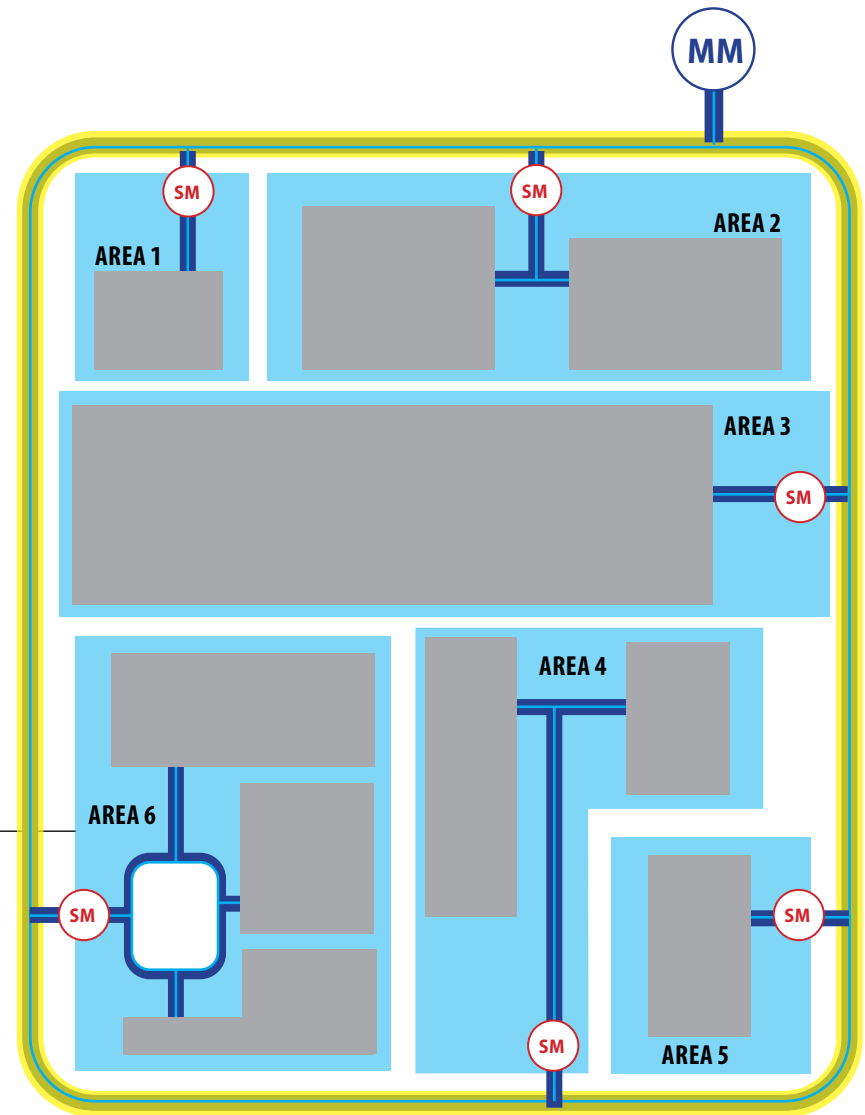
In this first stage of sub-metering the meters are best placed where the major T's branch OFF the main water distribution pipework and not the individual Main Buildings/Functions within these areas.



This sub meter will capture **everything** flowing into Area 6




This set up will only capture the water used within the individual buildings in Area 6.



 = Main Water Distribution Pipework

 = Mains Meter

 = Sub Meter

What Stage 1 tells you

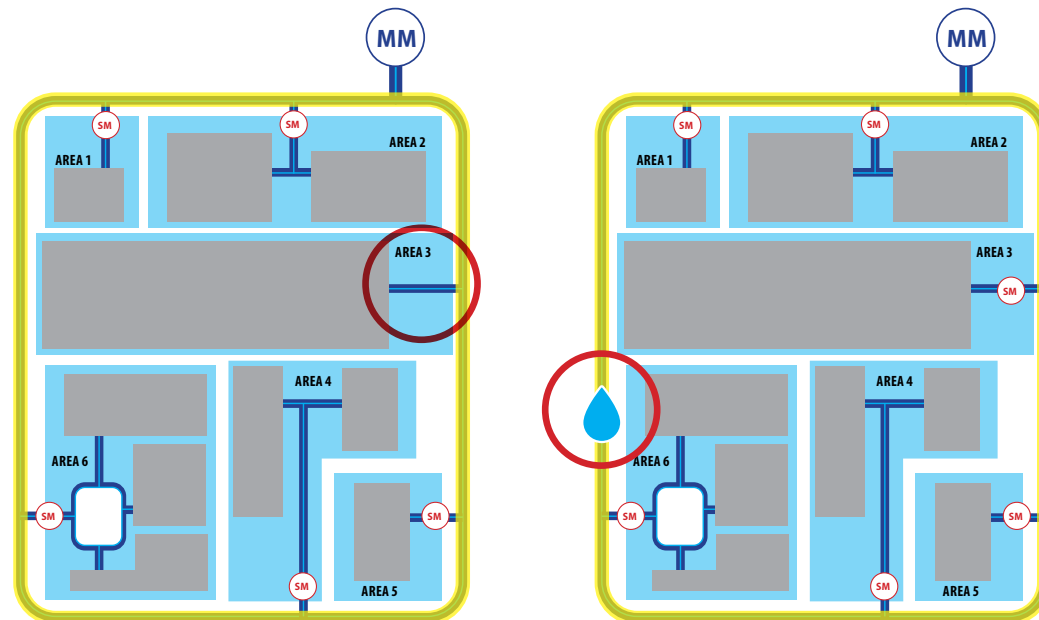
Once the sub-metering install is complete, a period of time should be allocated to analyse the data. The first thing to check is whether the collective readings of all the sub-metered **Water Usage Areas** equates to the volume recorded by the mains meter(s).

$$\text{SM} + \text{SM} + \text{SM} + \text{SM} + \text{SM} + \text{SM} = \text{MM}$$

If the readings **are not equal**, this usually indicates:

A. A missed placement of a sub-meter on a T branch off the *Main Water Distribution Pipework*

B. A leak in your *Main Water Distribution Pipework* - (yellow line)



Once Stage 1 of the sub-metering install is complete, and any potential issues identified and rectified, a second round of sub-meters may be warranted. Typically this will be for larger sites and entail sub-metering the main buildings or functions within the Main Water Usage Areas sub-metered in Stage 1.

This process will provide more granular information on the main end users around the site.

Note: if the network drawings are correct, it is most likely there are leaks.

Stage 2. Sub-Meter Main Buildings/Functions within your Water Usage Areas

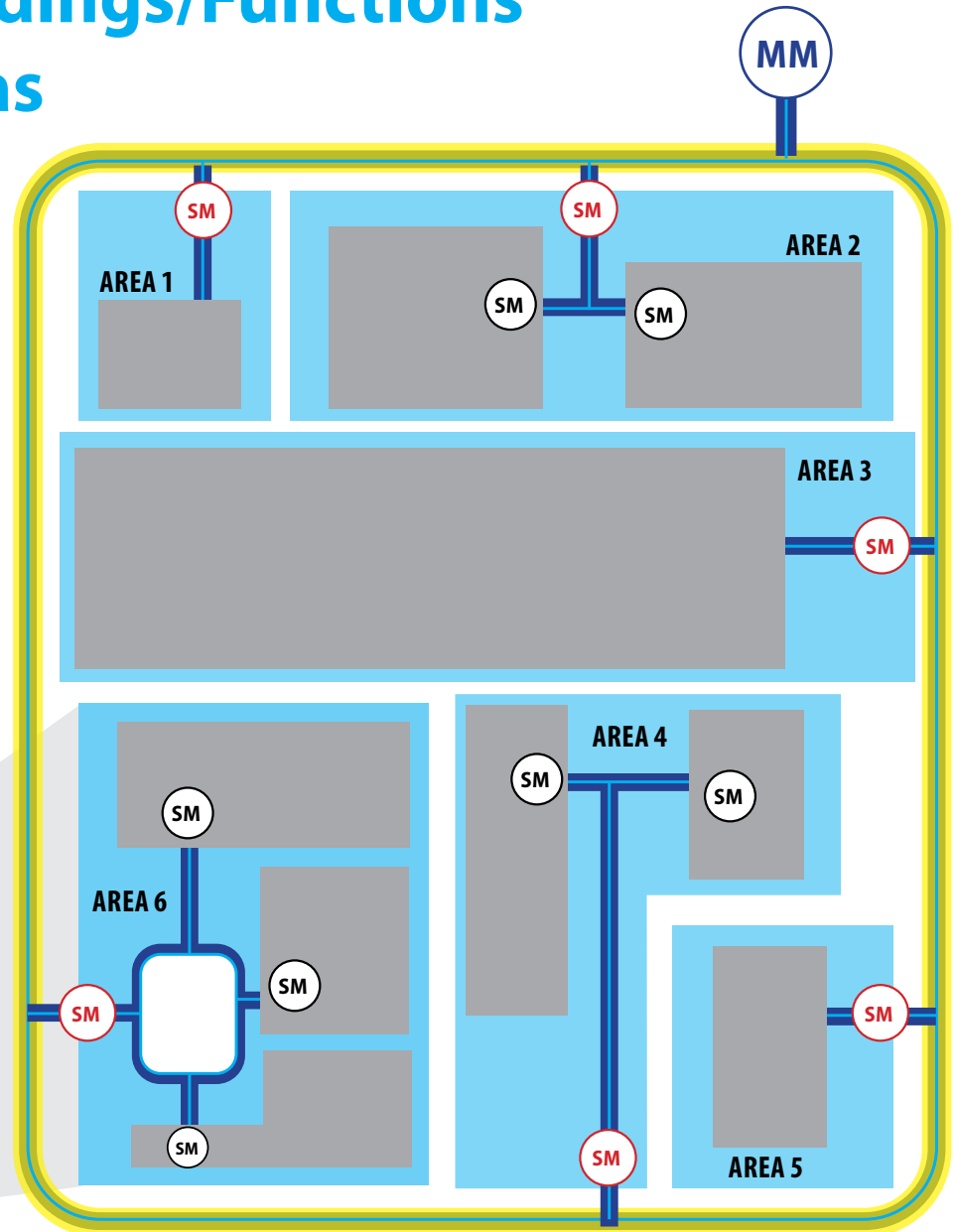
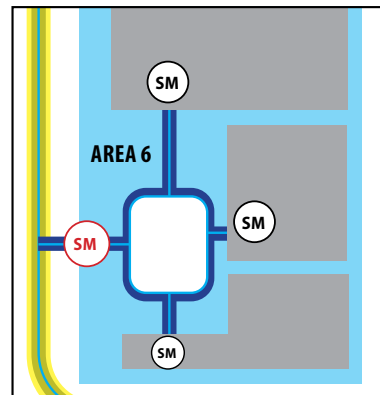
Sub-metering **Main Buildings/Functions** will effectively be sub-meters within the sub-metered **Water Usage Areas** from Stage 1 and will provide more information on the end users.

Main Buildings/Functions

Like Stage 1, the collective readings of all the sub-meters for your **Main Buildings/Functions** should be equal to the sub meter of the area they are contained in.

While this result would be ideal, realistically it's a target that might be met by constant review and repair.

$$\text{SM} + \text{SM} + \text{SM} = \text{SM}$$



4. The benefits of the sub-meter data

Setting up and installing a comprehensive sub metering system is not a linear process - while the steps involved are relatively consistent, every site is different and will require a unique solution that develops around the existing site infrastructure. Doing this will take time to implement fully but will ultimately provide the following information:

Site Coverage

As the sub metering system evolves, the system will identify how much of the site is covered (as a proportion of the mains water supplied) and help identify gaps where additional sub-meters may be required, or leaks may be occurring. This might seem obvious but prior to starting, most sites have little or no such live information/data relating to their site.



Usage Patterns

Once installed, the online sub-meters will allow daily and weekly patterns to be explored for the site (through the mains meter(s) and different sub-metered areas). By understanding these, and figuring out what 'normal' use is, alarms can then be set up through software to highlight when unusual spikes in water use occur.



Sharing the data

Knowing the most significant water consuming areas will help relevant staff or environmental teams identify where water conservation measures should be implemented.



You're not in the dark

Knowing the areas where there are leaks for repair gives any site a great head start in leak detection. If civil engineers, plumbers or leak detection experts are tasked with fixing these leaks then the system will help narrow down the location which means a quicker fix and less time on site.



5. Final points on data



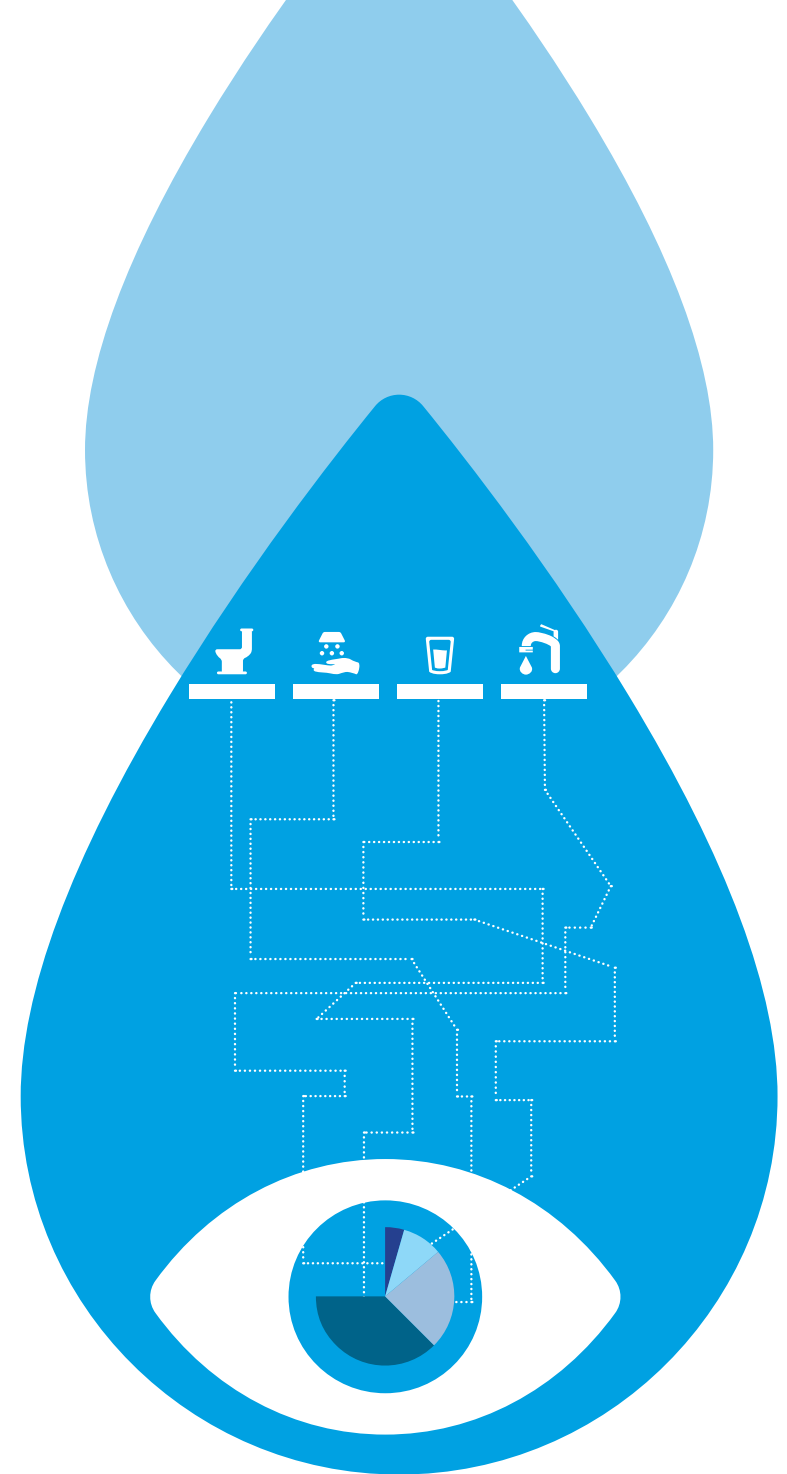
Delegate data access to the right people

Sub-metering systems can provide a wealth of information so it is essential that the correct people (on and off-site) have access to the system and that the data is analysed regularly.



Constant monitoring

From the outset, it is important to examine in detail the data gathered through the system. By analysing daily and weekly use profiles, investigating unexplained spikes and background water use, and ongoing monitoring of volumes used throughout the site, the sub-metering system will become a vital tool in improving the overall water performance of any healthcare facility.



Resources



Developing a long term water infrastructure strategy

Lessons learned from St. Finbarr's Hospital water conservation programme.



The benefits of ongoing water conservation & continual monitoring

A clear path to savings demonstrated by National Orthopaedic Hospital Cappagh



Uisce Éireann Leak Rebates

Find out about Uisce Éireann allowances and how to apply for the different options on their website.



Rainwater Harvesting

Learn how rainwater harvesting is one mechanism by which healthcare facilities can reduce their reliance on mains water supply.



Water Efficiency Booklet
A best practice guide for Irish Healthcare Facilities covering everything from Benchmarking to Reverse Osmosis.



Benchmarking Fact Sheet
Calculate the water use benchmark for your hospital by following this Benchmarking Fact Sheet.



Water Efficiency Poster
Inform staff about taking action to reduce water consumption in healthcare facilities.

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