MEASUREMENT & ANALYTICS

Water distribution – why measurement matters when every drop counts

How digital water management solutions are helping to tackle a global water crisis

Table of contents

004	**1.0 Introduction**
005	**Where is Earth's Water**
006 – 007	**Global trends affecting water use**
008	**2.0 Current Situation**
009 – 010	**3.0 Why is measurement important?**
011	**4.0 Measurement as a means of balancing supply and demand**
012 – 015	**5.0 Measuring throughout water distribution networks**
016 – 017	**6.0 How digitalization is offering new possibilities for enhanced measurement**
018	**7.0 Conclusion**
018	**References**

1.0 Introduction

Water is vital for life, yet despite 70 percent of the Earth's surface being covered in water, most is not available to sustain humanity. With 97 percent of water being contained in the world's oceans, it is too salty for drinking or growing crops. Only some three percent of the Earth's water is fresh, and the vast majority of that is locked up in ice caps and glaciers.

The remaining small percentage must meet all the potable drinking water and agricultural needs of a planet with a rapidly expanding population. Given this, it is not surprising that water scarcity is a growing issue across the globe, affecting every continent. Water scarcity can be caused by a physical shortage, or the failure of institutions to ensure a regular supply, or due to a lack of infrastructure to distribute water.

Water scarcity in numbers

The scale of the problem is summed up by some sobering figures. Approximately four billion people — almost half of the world's population — experience severe water scarcity for at least one month each year, while over two billion people live in countries with an inadequate water supply.

This lack of water could have profound social consequences, with 700 million people potentially being displaced by intense water scarcity by 2030. Lack of water also disproportionately affects women and children – spending time fetching water from great distances means they cannot do other things, such as improve their education or employment prospects. It has been estimated that by 2040, around 25 percent of the world's children will be living in areas suffering from extremely high water stress. [1]

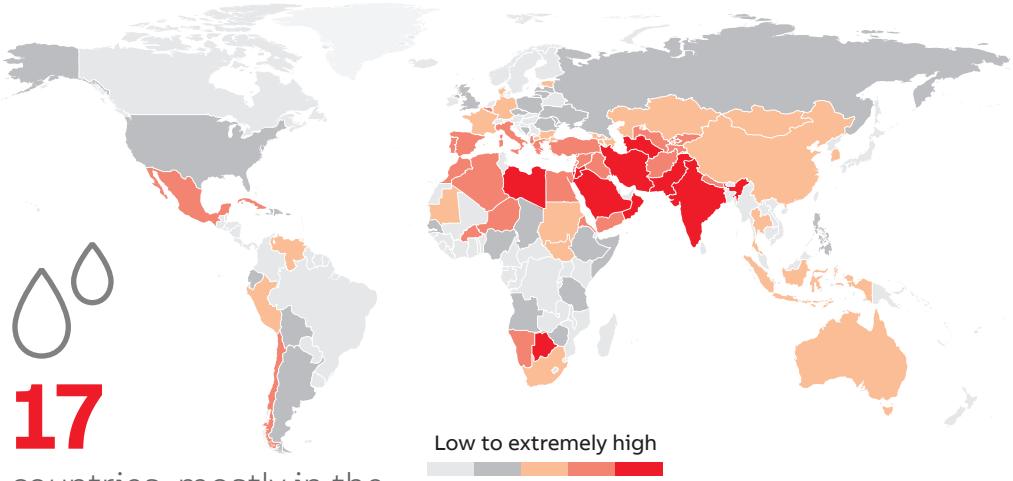
"It has been estimated that by 2040, around 25 percent of the world's children will be living in areas suffering from extremely high water stress."

Water scarcity takes two forms – physical and economic. Physical scarcity is the lack of sufficient water to meet demand while economic scarcity is due to poor investment in the means of getting water from rivers and other sources. Physical water scarcity particularly affects north Africa as well as central and west Asia while economic scarcity is a major problem in sub-Saharan Africa.

The biggest challenge facing countries around the world is how to get clean water to customers while also keeping distribution costs to a minimum and drastically reducing the amount of water that is wasted. While supplying water is a major issue, so is the fact that leakages account for over 45 million cubic meters of lost water every day [2]. In India, for example, pipeline water losses in the distribution system are higher than 45 percent, highlighting the need to make water supplies sustainable yet cost-effective. Clearly, reducing unaccounted for water (UFW) is essential.

There is economic benefit to fixing the water crisis globally. According to water.org, which works to tackle the issue in 11 countries in Asia, Africa, and Latin America, $260bn is lost every year around the world because of a lack of basic water and sanitation.

Figure 1 Countries at most risk from water crisis



17

countries, mostly in the Middle East, are at risk

Countries facing high water stress	
Rank	**Country**
1	Qatar
2	Israel
3	Lebanon
4	Iran
5	Jordan
6	Libya
7	Kuwait
8	Saudi Arabia
9	Eritrea
10	UAE

Source: World Resources Institute

Preserving water supplies
One of the key aspects in water supply is preserving existing sources by using them wisely and preventing them being affected by pollution. A key source is groundwater, which is found in aquifers, formations of rocks, sands, and gravels that hold substantial quantities of water. Accounting for approximately 99 percent of all liquid freshwater [3], it feeds springs, rivers, lakes, and wetlands. Recharged mainly from rain and snowfall infiltrating the ground, it can be extracted to the surface for use by pumps and wells.

In arid areas without substantial surface features such as rivers and lakes, groundwater is usually the only source. Even in relatively wet areas, groundwater aquifers remain an important source of water for drinking, sanitation, agriculture, and industry. In fact, almost all the liquid freshwater in the world is groundwater, and some 40 percent of all water used for crop irrigation comes from aquifers.

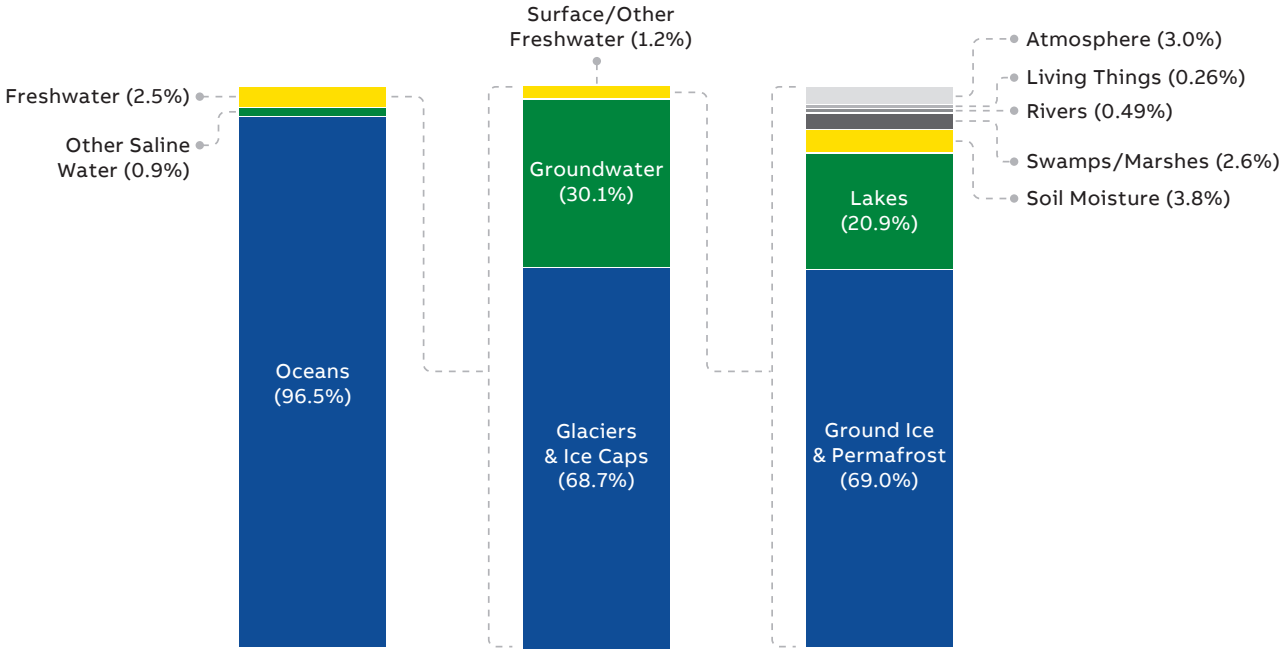
One major challenge is the preservation of groundwater. According to The Groundwater Project, groundwater hidden beneath the land's surface makes up 99 percent of fresh water and feeds rivers, lakes, wetlands, and ecological systems. The Groundwater Foundation lists ways of preserving groundwater as reducing chemical use, disposing of potentially toxic substances safely, fixing leaks and drips, not running water unnecessarily and reducing and re-using wherever possible.

Some areas of the world are putting their groundwater sources under growing stress, with Asia and the Pacific region having the lowest per capita water availability in the world. Use of groundwater in the region is predicted to rise by 30 percent by 2050.

This makes it critical to protect groundwater from pollution and overextraction by taking more water from aquifers than is replenished through rain and snow. In North America and Europe, nitrates and pesticides from agriculture are a major threat to groundwater quality, with 20 percent of EU bodies exceeding European standards on water quality due to pollution from agriculture. [4]

Protecting groundwater and using it sustainably is therefore vital if the world is to adapt to climate change successfully and continue to meet the needs of a growing population.

Where is Earth's Water



Global trends affecting water use

Several global trends are having a major impact on how water is treated and distributed, its availability, and how it is used.

- **Urbanization and development**
  Recent years have seen a major trend for people to move to cities, attracted by the higher quality of life and job opportunities that they provide. For the first time in human history, over half of the world's population live in towns and cities, a proportion that is set to rise to two-thirds by 2050. Less-developed regions are seeing the fastest population growth in urban areas, with the urban population estimated to grow from 3.9 billion people today to 6.3 billion in 2050. [5]

  This rise of urban dwellers has also caused a greater number of city inhabitants lacking safely managed drinking water, a figure that has increased by more than 50 percent since 2000.

- **Industrialization**
  Increasing industrialization has gone hand-in-hand with the growth in urban populations, as people demand more consumer and household goods. This brings consequences for water supplies, both in the greatly increased use of water for manufacturing, and the toxic chemicals that can get into the water supply. Many industrial units discharge wastewater locally without treatment, or as waste into lakes, rivers, and oceans. These can include pesticides, chemicals, waste oils, and heavy metals, which can be accumulated by humans and other living organisms in their tissues. Untreated sewage discharged into rivers can cause diseases like typhoid, dysentery, and cholera, while plant supplements like nitrate and phosphates can stimulate the growth of algae.

- **Agriculture**
  Agriculture looks set to remain the biggest user of water, with demand for new foodstuffs and products keeping water use high. These demands include a growing use of biofuels, which could require as much water as fossil fuels to produce. As populations grow, the demand for increased yields also rises. Another factor is a move away from basic staples such as starch-based foods, and a growing demand for water-intensive meat and dairy. [6]

- **Environment / climate change**
  As the climate changes, the availability of water is becoming less predictable. One of the growing threats is flooding, which can destroy water points and sanitation facilities, and contaminate water sources. Some regions are experiencing droughts that increase water scarcity and reduce people's health and productivity. Ensuring continued access to water is one of the major strategies as we seek to mitigate the effects of climate change.

  Other effects, such as higher temperatures and more extreme, less predictable weather, may alter the patterns of rainfall and snowmelt, and disrupt or alter river flows and groundwater, further reducing the quality of water. This is most likely to affect low-income communities, which are already the most vulnerable to any threats to water supply. Disruption to water supply will also affect health and food security and has already been shown to prompt mass migrations away from water-scarce areas. [7]

- **Decarbonization**
  Water production and distribution is highly energy intensive and contributes to a nation's carbon production. For example, in the UK, carbon emissions from domestic and non-domestic supply by water companies are 5.03 MtCO2e. This rises to 35 MtCO2e when household water use is factored in. [8]

  Many water companies have signed up to become carbon neutral. Although desalination has the advantage of providing an extra source of water that does not affect existing supplies, it is a very energy hungry process, which is sometimes provided by fossil fuels. The process needs to make more extensive use of renewable sources if it is to help reduce the carbon footprint of water treatment.

2.0 Current Situation

Losing precious water

It is estimated that around 126 billion cubic metres of water are lost worldwide through leaks every year, the equivalent of over 50,000 Olympic sized swimming pools. For water companies, this represents an annual revenue loss of $40 billion a year. Some 24 percent of countries have a non-revenue rate of greater 40 percent, revenue that could otherwise be used to fund investments in water infrastructure.

These enormous water losses have to be replaced, treated, and pumped again to maintain supplies to customers. This in turn uses more energy and resources, cutting the sustainability of water operations.

The number, extent, and duration of leaks, as well as the difficulty in detecting and correcting them, are affected by factors such as the operational strategy of the water utility, for example how it manages and controls pressures in the network. The length of mains pipes, their composition and age also have an effect, as does whether a particular area has predominantly more urban or rural customers.

Part of the challenge is that most pipework leaks remain hidden underground. Losses stemming from relatively small but steady leaks from a joint or fitting, can be especially hard to detect. This can pose particular difficulties where the pipe installation prevents water from rising to the surface. Because many of these leaks go unreported, many thousands of litres of water can be lost before the leak is fixed.

A big cause of these 'background leaks' is elevated supply pressures. While pressure is high, water is forced out into any existing leaks. New leaks can be generated at any points of strain such as joints in the pipework. The danger is exacerbated by older pipe work which may have suffered from corrosion and wear.

It has been calculated that reducing pressures can have a significant effect on leakage. A factor here is the Fixed and Variable Area Discharges (FAVAD) concept proposed in 1994. The velocity of flow of a leak varies with a Coefficient of Discharge (Cd) and the square root of pressure, but the area of some leakage paths may also vary with pressure. In fact, a 50 percent reduction in pressure gives a 65 percent reduction in leak flow rate. [9]

Whilst leakage is a major factor in water loss, it is not the only one. Poor measurement can lead to millions of litres of water being quantified incorrectly, which means nobody is quite sure exactly how much water is in a pipeline or where it is going. In irrigation applications, under-pricing of water is considered one of the main causes of over-consumption, so having accurate data on the exact amount of water used will enable users to be charged correctly for usage, which will have the effect of making them use supplies more carefully.

Another major problem is unauthorized or illegal water abstraction. As much as 30 to 50 percent of the world's available freshwater supplies are estimated to be stolen from water distribution networks every year, particularly in the agricultural sector [10]. This can often be a problem where regulators and users alike fail to attach a sufficient value to water – both financial and social – such that the need to control its use is not properly understood.

3.0 Why is measurement important?

Industrialization and development

Industrialization plays a significant factor in the battle to recognise the importance of managing water use around the world. Industrial companies are responsible for a huge amount of water consumption and many countries have systems in place to monitor this, often placing conditions on companies as to how they use and treat this precious resource and how they limit their impact on the environment.

—

"Being able to mitigate leakage in these countries becomes less of a goal and more an absolute necessity."

Other trends that have influenced recent significant increases in water consumption are urbanization and development. Clearly, the more houses and business premises that are built and the more cities expand, the greater demand there is for water and the need to recycle and re-use it – whether for domestic, commercial, or industrial purposes. Increasing tourism is another issue, with even more people applying pressure to a finite resource.

Take China or India, for example, where growing urbanization is putting significant stress on the water networks in those countries. Being able to mitigate leakage in these countries becomes less of a goal and more an absolute necessity. With a population of 1.38bn, India not only has some of the world's largest and fastest growing cities but also has significant growth in industrial sectors including textiles and agriculture which require huge volumes of water.

In Bangalore alone, the expanding population is placing increasing stress on the available water supplies. Water theft can also be a major problem for countries like India that have targets for the amount of water that is available 24 hours a day. The biggest challenges are inadequate data, inefficiencies in water distribution network systems, poor operating practices, and losses in pipelines. To solve these problems, work is focusing on improving metering and billing, improving revenue generation, ensuring an equitable supply for everyone with adequate pressure and reducing water losses. Strategies for reducing UFW in cities in India look at improving supply, ensuring proper usage and cutting potable water production.

Climate change

Other regions and countries affected include the Middle East, with rapid development underway in Dubai and Riyadh, and Europe with its ageing water infrastructure in certain areas and wider use of irrigation in southern Europe. Likewise, in major USA cities such as California, prolonged droughts due to climate change have put overwhelming pressure on water systems.

Also, as populations continue to grow globally and there is an increased need to produce more food, the agricultural sector becomes an ever-larger user of water, especially for irrigation which accounts for 70 percent of the water that the sector uses. Although there have been major advances made to municipal distribution systems and a move towards more modern irrigation systems that use pressurized pump-fed supplies, many irrigation systems are still based on traditional methods.

—

"As populations continue to grow globally there is an increased need to produce more food"

It's already been mentioned that the use of water is an important factor in terms of the environment, but it also applies the other way around – with climate change having a negative impact on water levels, reservoirs, irrigation, and a range of other water distribution systems.

Revenue control

For water utilities, getting more information on non-revenue water offers a great chance to improve financial viability and boost the immediate and long-term availability of water supplies.

While significant advances have been made in reducing water losses in recent years in various parts of the world, a significant amount of the clean water that utilities produce and distribute continues to be unaccounted for, either through real losses caused by leaks and burst pipes, inaccurate flow measurements or unauthorized extractions from pipelines. Cumulatively, this can result in lost revenues running into billions of dollars per year, impacting not only on the operating profits and viability of water utilities but also the capital available to invest in improving water networks.

With all the above in mind, it's clear that the optimal way to monitor and manage water consumption is by taking measurements that will produce accurate data. Only through measurement can organizations and countries hope to manage supply and demand, optimize the amount of energy that is used in water collection and distribution systems and reduce the costs of treatment by directing resources only to areas where treatment is required. Of course, cost management is also improved considerably when armed with the most up-to-date and accurate data. Billing accuracy is essential for all parties concerned in order to manage costs more effectively and for costs to be distributed more fairly. Maximising revenues provides a valuable source of funding for future improvements that can bring water to even more people.

4.0 Measurement as a means of balancing supply and demand

The fundamentally imbalanced nature of the equation between the finite supply of available fresh water and the demand placed on it by a growing population makes tight control and management of water supplies vitally important.

We have already seen some of the issues influencing the demand for water and the challenges, such as water losses through leakage and other factors such as inaccurate measurement and unauthorized extraction, that can impact on water supplies.

By measuring as widely as possible throughout water distribution networks, operators can identify whether water supplies are being optimized by being able to more effectively track the quantities that leave water treatment works and compare them with what reaches consumers. By using the resulting data, strategies can be devised for tackling the key areas of leakage reduction, demand reduction and supply management to enable more effective control of water supplies.

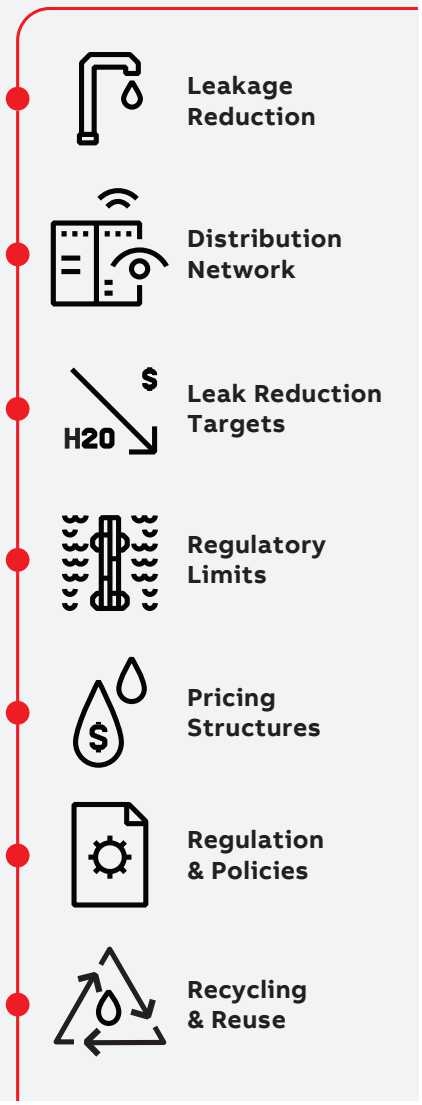
The holistic approach to conserving water supplies

The need for sustainable water management has necessitated the exploration of various methods to save water. Leakage reduction, demand reduction, and supply management are three distinct approaches that together can make a major contribution to water conservation.

- **Leakage reduction:**
  Leakage reduction focuses on minimizing water losses from distribution networks. It involves identifying and repairing leaks promptly to minimize wasted water. Measurement also helps to ensure that leak reduction targets are being met.

- **Demand reduction:**
  Demand reduction focuses on decreasing water consumption by promoting efficient use and behavioral changes. Measures can include regulatory limits, including pricing structures and incentives to encourage reductions in water use. Other measures can also include techniques such as water metering and educational initiatives to teach users about the importance of conserving water supplies and the measures available to help them do it.

- **Supply management:**
  Supply management is focused on measures to optimize and control the availability of water. Techniques can include regulation and policies to ensure equitable distribution, prioritize water usage, and address competing demands from various sectors. It can also include measures to encourage recycling and reuse of water to reduce pressure on freshwater sources, as well as building out infrastructure such as reservoirs, water transfer systems and treatment plants to expand and support freshwater supplies.



5.0 Measuring throughout water distribution networks

Effective management of water starts with accurate measurement, with a range of measurements, from flow, pressure, and level through to water quality, helping to ensure that freshwater supplies are maximized and made available to as many people as possible. The following are descriptions of some of the key stages involved in water distribution and the methods and equipment used to measure and manage them.

Bulk water distribution

The efficient distribution of large quantities of water from its source to multiple distribution points relies heavily on accurate measurement for optimizing water allocation, minimizing waste, maximizing quality, and facilitating effective planning.

As such, it is vital to ensure that water is measured as widely as possible using a variety of instruments to keep a check on flow and other key parameters including pressure, level, and water quality.

Measurement of these parameters serves a number of purposes within bulk water distribution.

Measurement of these parameters serves a number of purposes within bulk water distribution.

Volume and flow rate monitoring

Even the best maintained water networks will have some degree of water loss, stemming from a variety of factors including leakage, measurement inaccuracies or water being withdrawn illegally. Measuring water volume and flow rates helps to assess and identify these losses by enabling utilities to effectively manage and allocate their water resources. It assists in monitoring water distribution, detecting discrepancies, and mitigating losses resulting from leaks or unauthorized usage.

Leakage detection and control

A combination of factors including age, pipeline materials and the vast scale of water distribution networks means that wasteful leakage can occur anywhere.

Although the size of a hole may often be tiny – in some cases no larger than a pin – the extent of water losses through leakage can be considerable, particularly where they go undetected for long periods of time. It is these types of losses, rather than the more easily identifiable, large-scale losses, that pose the biggest problem for water operators. As a means of detecting these losses, measurement serves an essential function in the detection and management of leaks within the distribution network. Through the continuous monitoring of flow rates and pressure fluctuations, unusual patterns suggestive of leaks can be pinpointed, enabling swift repairs, and reducing water wastage.

System modelling

Being able to optimize system performance makes it vital for operators to be able to understand what is happening within the distribution network at all times. Accurate measurement has a major role to play in enabling this, by providing the data needed to develop hydraulic models of the distribution system. By feeding these models, instrument data enables simulation and optimization of key parameters including pressure levels, flow patterns and distribution. As an accurate reflection of network conditions, these models can be used to ensure a reliable and sustainable water supply by enabling effective planning, resource management and operation.

Type of instrument / technology	Benefit
Electromagnetic flowmeters	Suited to large pipe sizes Accurate measurement at high flow rates
Ultrasonic flowmeters	Non-intrusive design makes them ideal where cutting pipes is not feasible
Venturi & Orifice plate differential pressure flowmeters	Simple and reliable measurement based on differential pressure flow
Pressure transducers	Can be used to determine pump efficiency, detect leaks and monitoring pressure variations
Level sensors	Can be used to measure water levels in storage tanks, reservoirs or other storage facilities to ensure sufficient water is available for distribution
Water quality sensors	Can be used to measure key quality parameters, including pH, conductivity, chlorine and turbidity

Pumping stations

The crucial role played by pumps in transporting water around a distribution network means ensuring they are working at optimum performance. Measuring both flowrate and pressure can help to identify if a pump is working efficiently and enable potential problems to be spotted and rectified before they can escalate. With pumping accounting for a major percentage of a utility's energy costs, measuring pump efficiency also presents the opportunity for operators to reduce energy wastage, and prolong equipment lifespan.

Measurement instruments can be used to monitor and assess a variety of parameters, making them suitable for applications including:

Pump performance monitoring
Using instrumentation to measure key parameters such as pressure and flow can provide a valuable indication of pumping station performance. Using measurement data, operators can assess pump efficiency and identify any potential issues such as deviations that could indicate the need for maintenance or adjustments.

Energy optimization
Pumps need to be kept at optimum performance to ensure they offer the best possible levels of energy efficiency. Comparing flow and pressure rates against power usage enables opportunities for efficiency improvements to be identified, opening the way for reductions in energy consumption and providing valuable data for energy saving strategies.

Anomaly detection and maintenance
Measuring pressure, flow rates, and vibration can be instrumental in identifying irregularities within a pumping system. Sudden deviations from typical values can serve as indicators of potential pump malfunctions, leaks, or system abnormalities. Detecting these issues early enables timely maintenance, decreasing downtime and reducing the risk of equipment damage.

System control and optimization
Data collected within pumping stations can play a key role in system management and enhancement. By continuously tracking flow rates and pressure in real-time, operators can fine-tune pump speeds, improve valve control, and optimize system efficiency to maintain desired pressure levels and ensure a continuous and efficient distribution of water.

Type of instrument / technology	Benefit
Electromagnetic flowmeters	Suited to large pipe sizes Accurate measurement at high flow rates
Ultrasonic flowmeters	Non-intrusive design makes them ideal where cutting pipes is not feasible Suitable for large range of pipe sizes
Turbine flowmeters	Measure flowrate by calculating rotational speed of a turbine in the flow stream. Well-suited to measuring high flow rates
Pressure transducers	Can be used to detect system anomalies and ensure optimum pressure conditions
Power meters	Can be used to assess pump efficiency, energy consumption and provide insights for energy optimization
Vibration sensors	Detect abnormalities or faults in pump operations, enabling timely intervention to prevent equipment failure

District Metered Area (DMA) networks

District Metered Area (DMA) networks segment the water distribution system into smaller zones, enabling more precise control and surveillance and the detection of leaks. Precise measurements within these DMA networks are crucial for pinpointing water losses, tracking consumption trends, and refining water resource management.

An effective DMA scheme will utilize a combination of flowmeters, pressure transducers, data loggers and communications systems such as Supervisory Control and Data Acquisition (SCADA) or telemetry systems to provide real-time monitoring and analysis of data that can be used to target and rectify leaks as well as optimizing network performance.

Leak detection
Accurate measurements of flow rates and pressure within the DMA network facilitate the identification of leaks. By comparing the water supplied to the DMA with the water consumed in the area, any disparities indicating potential leaks can be pinpointed. Precise measurements play a crucial role in leak localization, reducing water losses, and mitigating damage to the distribution system.

Consumption monitoring
Flow rate and pressure measurements within the DMA network enable the tracking of water consumption patterns. By analyzing consumption data, utilities can spot irregularities, identify demand trends, and implement strategies for effective demand management.

Pressure control and optimization
Pressure measurements within fire service mains are of paramount importance for maintaining the requisite water pressure during emergencies. Pressure monitoring guarantees that the necessary pressure levels can be achieved to ensure water is available for fire hydrants, standpipes, and sprinkler systems.

Performance evaluation and optimization
Measurements taken within the DMA network provide valuable data for evaluating the overall performance of the distribution system. By scrutinizing flow rates, pressure readings, and consumption patterns, utilities can identify areas in need of improvement, optimize pipe sizing, and make well-informed decisions regarding network upgrades or modifications.

Type of instrument / technology	Benefit
Electromagnetic flowmeters	Suited to large pipe sizes and offer accurate measurement at high flow rates
Ultrasonic flowmeters	Non-intrusive design makes them ideal where cutting pipes is not feasible. Suitable for large range of pipe sizes
Vortex flowmeters	Reliable performance and ability to handle range of flow conditions
Pressure transducers	Can be used to detect pressure variations and system anomalies and ensure optimum system performance
Data loggers	Record and store data from instruments throughout the DMA network, which can be analyzed to identify issues such as leaks, pressure variations, etc.
Communication systems	SCADA (Supervisory Control and Data Acquisition) or telemetry systems enable proactive network management through real-time monitoring, remote control and data analysis

Fire service mains

Ensuring an adequate supply of water for fire service mains in the event of firefighting and emergency situations is essential to public safety. For this reason, accurate measurements within these fire service mains are critical to guaranteeing ample water flow and pressure when facing critical situations.

Adequate water supply
Accurate measurements of flow rates and pressure within fire service mains ensure an ample water supply during firefighting operations. By continuously monitoring flow rates, operators can verify that an adequate volume of water is being delivered to the fire site to enable effective firefighting.

Pressure control
Pressure measurements within fire service mains are of paramount importance for maintaining the requisite water pressure during emergencies. Pressure monitoring guarantees that the necessary pressure levels can be achieved to ensure water is available for fire hydrants, standpipes, and sprinkler systems.

Leak identification
Flow rate measurements serve as a valuable tool for detecting potential leaks within fire service mains. Significant deviations in flow rates can signal the presence of leaks, allowing operators to promptly pinpoint and rectify them. Swift leak detection and repair efforts contribute to the conservation of water resources and the preservation of the integrity of the distribution system.

System performance assessment
Measurements conducted within fire service mains furnish data for assessing the overall performance of the distribution system. By analyzing variations in flow rates and pressure, utility authorities can evaluate the effectiveness of water delivery, identify areas that require enhancements, and make well-informed decisions regarding potential system upgrades or modifications.

Type of instrument / technology	Benefit
Electromagnetic flowmeters	Suited to large pipe sizes and provide high accuracy measurement across full range of flow rates
Ultrasonic flowmeters	Non-intrusive design makes them ideal where cutting pipes is not feasible Suitable for large range of pipe sizes
Pressure gauges	Are used to measure pressure levels and detect abnormalities that could affect supply of water during firefighting operations
Control valves	Positioners or flow control devices help to control water flows to ensure sufficient supply of water during firefighting operations

Maximizing water quality

With water availability and quality becoming an area of concern within sensitive locations, water treatment facilities are looking at additional measures to ensure maximum availability of safe drinking water. A largely overlooked element is the use of continuous online water analysis for disinfection dosing and control.

Chlorine is commonly used to maintain residual disinfection in the drinking water network. This prevents the growth of bacteria in the water network after disinfection is complete at the water treatment plant maximizing the availability of safe drinking water to customers. The residual benefit of using chlorine for disinfection makes it more effective than other methods (e.g. UV) that don't continue to treat the water once it leaves the treatment plant. It is important to maintain water quality throughout the water network and for this reason there are legal limitations set by countries around the world; water companies use chlorination as a key part of their strategy.

In addition to disinfection, chlorine can be used as a pre-treatment to reduce chemical use and optimize operation of the water treatment facility. Chlorine is effective at removing things like manganese, iron and even hydrogen sulphides which can cause staining and/or unpleasant odours but more importantly it reduces the demand on the coagulation stages of water treatment stage, improving overall efficiency.

ABB Measurement & Analytics is a global leader in continuous water analysis, enabling customers to measure water quality continuously and accurately throughout the water cycle. Our trusted range of water analysis solutions provide real-time data on process conditions that can be used to improve efficiency, tighten performance, and safeguard quality. With over 70 years of experience treating water, we provide both electrochemical and optical sensing technologies as well as the hardware and digital solutions to ensure the highest water quality is maintained throughout the distribution process.

6.0 How digitalization is offering new possibilities for enhanced measurement

We've established that monitoring and measurement of key parameters including flow, pressure and level are the optimal ways for identifying and minimizing water wastage and ensuring that water distribution is as effective and efficient as possible.

—

"Operators in the field are now able to carry out remote diagnostics and have remote access to real-time data without the possibility of any lag or any outdated data being used."

In the 21st century, digitalization is playing an increasingly important role in this area. This gives water management organizations the ability to carry out preventative and predictive maintenance (tackling incidents before they occur, cutting costs and maximising productivity). Digitalization also ensures processes are optimized because their operations are based on the most accurate data available. At the same time, operators in the field are now able to carry out remote diagnostics and have remote access to real-time data without the possibility of any lag or any outdated data being used. Digitalization also gives organizations the opportunity to carry out maintenance tasks using augmented reality (AR) and virtual reality (VR), ensuring greater safety for operators, higher levels of accuracy and the ability to have a visual record of maintenance operations.

ABB Measurement and Analytics is recognised globally as a single source supplier of safe, smart, and sustainable solutions across the whole water cycle. With over 50 years in the water industry and 130 in the power business, ABB offers solutions in water intake and treatment, transportation and distribution, wastewater collection and treatment, with the goal of making safely treated clean water available where and when it is needed. For example, the company's variable speed drives and scalable PLCs with built-in application functionalities and features control water flow, pressure, and level efficiently while saving energy. Likewise, energy-efficient motors and drives enhance every stage of the water process while measurement and analytical products ensure users meet their goals and targets.

Digital measurement and analysis solutions for boosting efficiency cover flow measurement, temperature measurement, pressure measurement, analytical measurement, level measurement and recorders and controllers. ABB equipment monitors electromagnetic flow, variable area flow, ultrasonic open channel flow, Coriolis flow, Vortex/swirl flow, mass flow, residual chlorine, ammonia, conductivity, pH, phosphate, redox, turbidity, dissolved oxygen, fluoride, QRP and much more. Whether dealing in residential use, business use, treatment plants, pumping stations, stormwater, sedimentation, water storage, boreholes, desalination or coagulation, ABB manages the entire water cycle, handling user's assets from the field to the cloud.

Measure every drop accurately

For example, ABB's AquaMaster electromagnetic flowmeter was developed to improve the management of potable water distribution networks. Designed to simplify revenue applications, district metering, leakage management and irrigation, the flowmeter enables information to be sent via mobile telecommunication (4G, NB-IOT), enabling operators to locate difficult, small or slow leaks almost at the time that they happen.

The AquaMaster4 electromagnetic flowmeter and mobile comms family are designed to "measure every drop accurately" and are particularly suited to water distribution applications in DMAs. The meter, which measures bi-directional flow as standard, logs and communicates using a single box, reducing capital expenditure, and boosting billing confidence through accurate records of actual consumption levels.

Reduced bore sensors in sizes 40mm to 600mm offer high accuracy at low flows and a wide operating flow range while IP68 rating on the sensor, transmitter and cables enables the sensor to be buried at depths of up to five meters. The mains or battery-powered flowmeter can be programmed to display forward and reverse flow rate, forward, reverse, and net flow totalizers, flow velocity, date, and time as well as pressure. As standard, the meter also displays the following alarm conditions: low battery, sensor fault, empty sensor, mains power failure, low GSM signal and renewable energy not present. The AquaMaster4 meter delivers measurement accuracy down to flow velocities lower than 0.1m/s where most meters struggle even to detect flow.

ABB flow measurement solutions have found applications around the world, including China, India, the Middle East, Europe and the USA – particularly in areas where water shortages are a major problem due to high municipal and industrial demand while the agriculture sector is highly water intensive.

Reliable measurements

In Tianjin, China's third largest city with a population over 15m, water measurement was a major issue due to a rapid rise in water consumption through increasing demand from industry, agriculture, and the burgeoning population. The Tianjin Water Company and its water treatment partner Veolia needed to have reliable measurements of the volume of source water that was transferred to and treated by Veolia. The partners had previously used ABB's electromagnetic flowmeters on other projects and chose ABB's larger diameter WaterMaster meter to enable reliable monitoring of water flow rates as well as accurate calculation of water revenue.

In the Koppal district of Karnataka in India, ABB delivered digital solutions for effective water management that are easing water shortages in the area. The population of about one million has suffered from water shortages for some time, relying on ancient wells and out-of-date water conservation practices. The ABB solution, based around AquaMaster4 electromagnetic flowmeters and the company's Ability Symphony Plus SCADA to supervise and control operations, was provided to L&T Construction Water & Effluent Treatment IC, the lead contractor for the project.

The result was integrated information management as well as integration of equipment and process optimization that ensured maximum reliability and availability of water plants and networks. The SCADA system helps to monitor and analyse daily flow consumption patterns, identifying possible leaks and sending the information in real-time to a central control room. Of course, identifying leaks early means they can be repaired quickly, and water loss can be minimized. ABB flowmeters are also in operation in other areas across India, including Delhi, Bangalore, Surat, Ranchi, Kolkata, Udaipur, Chennai, and in semi urban and rural areas like Gadag in Karnataka and Jawai in Rajasthan.

7.0 Conclusion

Water is an incredibly precious resource and urgent action is required to tackle the issue of water being lost in water distribution networks. Measuring water flows and producing accurate data, from which water companies can manage supply and demand better, is the way forward.

By using the latest technologies offering the highest levels of performance and accuracy and deploying them as widely as possible throughout water distribution networks, water utilities have the opportunity to transform water sustainability through greatly enhanced control and management of water supplies.

References

[1] https://www.unicef.org/wash/water-scarcity#:~:text=Key%20facts,by%20as%20early%20as%202025.

[2] https://waterintelligence.co.uk/water-facts/

[3] https://www.unwater.org/publications/un-world-water-development-report-2022/

[4] VoxEurop – Investigating Europe's water pollution crisis: Blame it on industrial farming (2023)

[5] https://www.unwater.org/water-facts/urbanization/

[6] https://www.unwater.org/water-facts/water-food-and-energy/

[7] https://www.unwater.org/water-facts/climate-change/

[8] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/291728/scho0708bofv-e-e.pdf

[9] https://core.ac.uk/download/pdf/42606091.pdf

[10] https://www.nature.com/articles/s41893-020-0589-3

ABB Measurement & Analytics
For your local ABB contact, visit:
www.abb.com/contacts

For more product information, visit:
www.abb.com/measurement

Water distribution – why measurement matters when every drop counts-EN 09.2023