

Handling the pressure: Why intelligent pressure management is the key to addressing water supply issues



Introduction

We need to talk about water. And more specifically, we need to talk about how we use the water we have more efficiently. Reports estimate that global water demand will outpace supply by 40% by 2030. In many countries, more than 30% of treated water does not make it to the end user. This latter statistic points to one of the central challenges facing the water distribution industry: an outdated water infrastructure.

In the United States, leaking pipes lost the equivalent of USD 7.6 billion worth of treated water in 2019. And this rate is expected to increase to USD 16.7 billion by 2039¹. A similar situation exists in the European Union. According to an OECD report, most Member States will need to spend between EUR 500–1,000 more on water supply and sanitation per person to comply with existing water regulations by 2030².

In this white paper, we will examine how many of the challenges facing water utilities stem from pressure management. We will explore how intelligent water pressure management can help alleviate these issues, while:

- Improving the efficiency, reliability and safety of water distribution systems,
- Preventing leaks, bursts and service interruptions, and
- Reducing operational costs and extending the lifespan of critical water infrastructure.

¹ ASCE (2020). The Economic Benefits of Investing in Water Infrastructure: How a Failure to Act Would Affect the US Economic Recovery.

² OECD (2020). Financing Water Supply, Sanitation and Flood Protection: Challenges in EU Member States and Policy Options. OECD Studies on Water.

Water utilities worldwide are struggling with pressure-related challenges

Pressure plays a critical role in water pumping, handling and distribution. To make sure the most remote customers have the minimum pressure they need, water distribution networks often operate with different pressure levels across the network. In many cases, however, this pressure level is much higher than necessary. If there are leaks in the system, the higher pressure means even more water is lost. Excessive pressure in a pipe also increases the likelihood of leaks occurring, particularly in older or more fragile networks. This combination of uncontrolled pressure and lack of real-time pressure monitoring can lead to:



High energy consumption and water loss



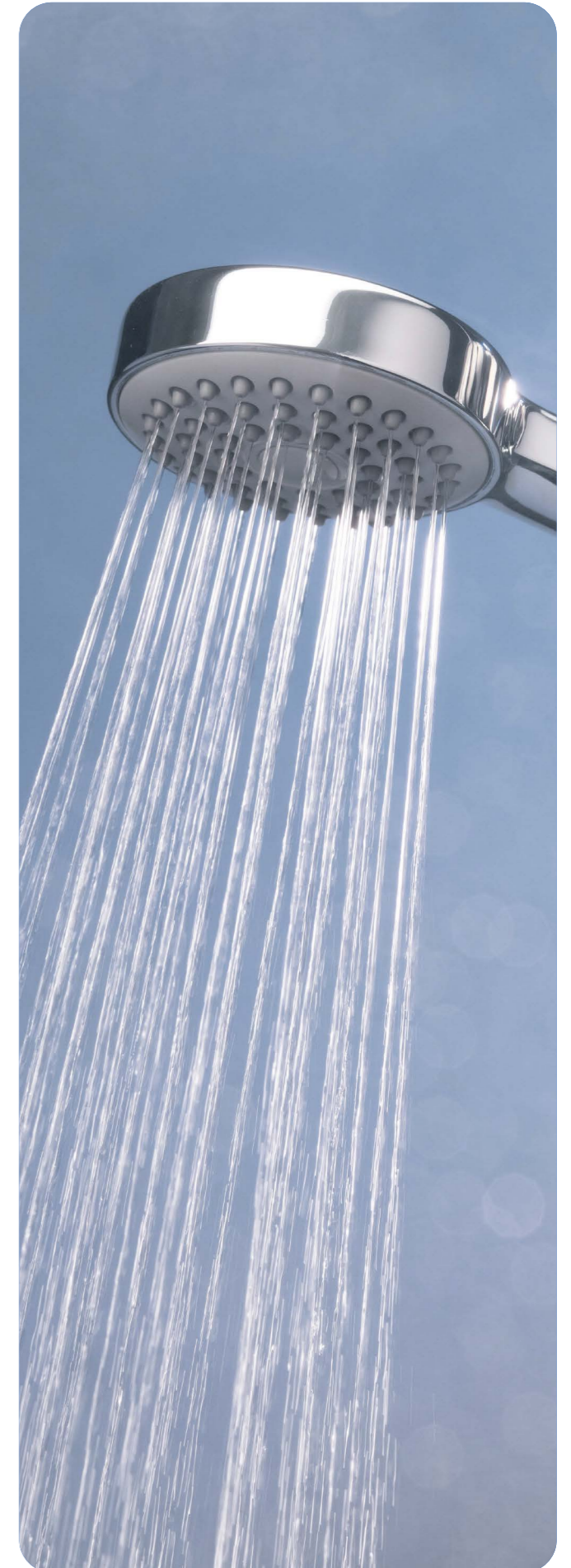
Damaged pipes



Expensive system downtime due to unpredictable maintenance



Dissatisfied end-users due to lack of water



How pressure management solves these challenges

For most water utilities, upgrading or replacing all the pipes in their water distribution network is economically infeasible. Intelligent pressure management can be a cost-effective way of preventing leakage and ensuring more efficient water distribution within the existing network, prolonging its lifetime. Pressure management is about lowering the water pressure by **splitting the network into pressure zones**. Thus, instead of running the same high pressure throughout the network, you modify it to keep pressure levels more stable and matched to local needs.

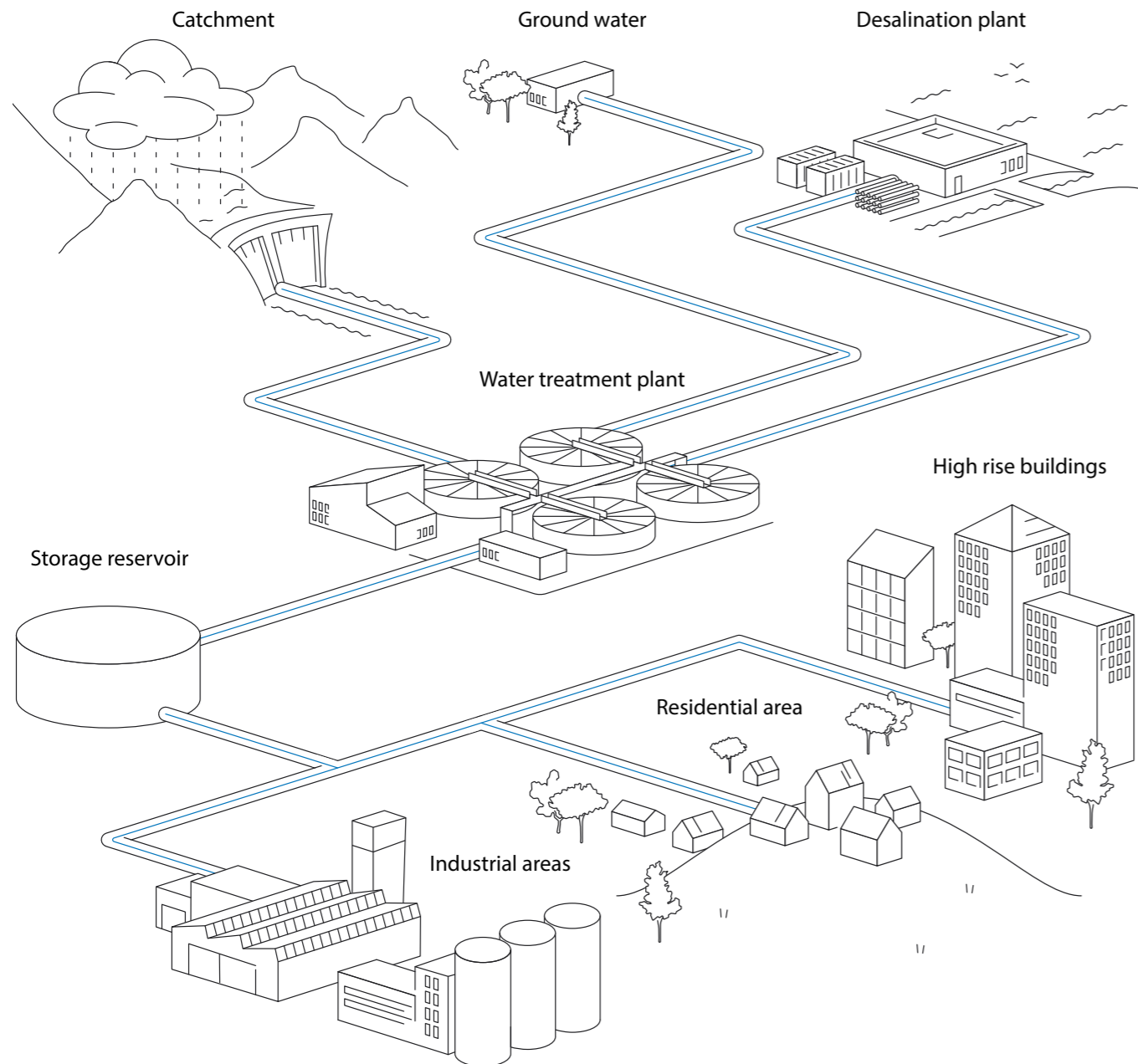


Figure 1: An example of a water distribution network divided into pressure zones

Managing pressure at every step of the water cycle

In many countries, pressure zones are already a standard approach in water distribution. By strategically placing pressure sensors, switches, and variable speed drives throughout the network, utilities can optimise pump and booster pump operation. This not only ensures stable and reliable water pressure, but also **improves energy efficiency, reduces water loss, and extends equipment lifetime**.

Pressure sensors installed at the pump outlet or manifold continuously measure discharge pressure. This data is

then fed into the pump control system, which adjusts motor speed or pump staging to maintain the target pressure despite fluctuating demand. In the overall water distribution chain, pumping stations positioned across the network maintain system pressure according to the city's geography, ensuring reliable supply to areas at different elevations. Accurate, real-time pressure measurement ensures that the rest of the network operates within optimal parameters, **reducing stress on pipes, valves and downstream equipment**.



Uncover More Possibilities with Danfoss



As effective pressure management depends on stable, responsive pump control, the dedicated VFD (Aqua-drives) from Danfoss provides the intelligence and real time adaptability utilities need to optimize their water distribution systems. Its dedicated water functions, robust performance, and digital capabilities make it well suited for applications ranging from primary pumping stations to complex multi pump zones in municipal networks.

Next, automatic control valves strategically placed throughout the network regulate pressure and flow between the different zones. These valves respond **quickly** and **accurately** to changing conditions, such as sudden spikes in demand, without causing pressure surges or water hammer. Here, it's important that the pressure sensors installed have a rapid response time, sending the necessary information to the valve so it can react quickly to pressure changes.

Pressure zones and real-time pressure monitoring can also be applied effectively at the building level. Water managers often face challenges in maintaining adequate pressure on the upper floors of high-rise buildings due to elevation and friction losses. This issue is commonly addressed through secondary water supply systems, which create pressure zones within the building using a combination of booster pumps and pressure-reducing valves. By installing pressure sensors at key points in the building's plumbing system—such as at pump outlets, valve inlets, and critical floor levels—building managers can **monitor pressure in real time**. The collected data can be sent to the building's control system to adjust pump speed or valve settings, ensuring **balanced water pressure across all floors**.

Water utility managers can also use this pressure data to **maintain service quality, protect infrastructure, and identify potential issues before they escalate**. Danfoss actively participates in development projects aimed at optimizing these systems, with a strong focus on improving energy efficiency. This commitment ensures that pressure management solutions not only deliver reliable performance but also contribute to sustainable, cost-effective operation.

Pressure management enables network optimization

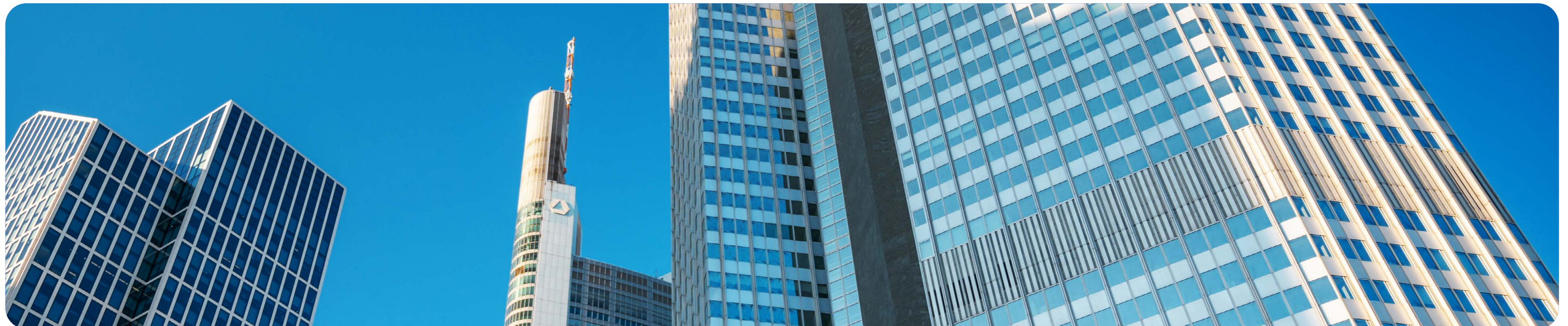
Measuring pressure is also crucial for optimizing water distribution networks. By implementing pressure sensors at strategic points within the network, utilities gain valuable real-time insights into system performance. This data enables key benefits:



Pressure variations can indicate leaks, allowing for faster response times and reduced water loss.



Understanding pressure patterns helps optimize system pressure, reducing stress on infrastructure and lowering the risk of pipe bursts.



Intelligent pressure management in action

Does all of this amount to measurable benefits for water utilities? A 2018 global study of water distribution systems evaluated experiences from **112 pressure zones** in **10 countries**. The facts revealed significant benefits of intelligent water pressure management, including:

38%

average pressure reduction in the pipe systems

53%

reduction in new breaks in the pipe systems

38%

reduction in water leakage

20–40%

reduction in energy consumption

Other benefits included an **extended** asset lifetime for piping, **fewer** network-related complaints and **reduced** costs for the water utilities.

The city of Aarhus in Denmark has also experienced the benefits of intelligent water management. The city's water utility, Aarhus Water, supplies 300,000 people with 15 million m³ of water each year. Interested in finding ways of optimizing its water distribution network, the utility analysed its entire water infrastructure and divided the city into pressure zones.

A long-term Danfoss partner, Aarhus Water worked with the company to install pressure sensors and variable speed drives throughout the network, to help it monitor and manage the pressure in each zone. Pressure management, together with active leakage control, speed and quality of repairs, pipeline management and rehabilitation, means that Aarhus Vand has reduced its leakage rate to 5%, considerably below the average global leakage levels of 25–30%.



The DST P140 Pressure Sensor – Built for Intelligent Water Pressure Management

As we've discussed, accurate, reliable pressure management is essential for allocating water resources efficiently. The DST P140 pressure sensor from Danfoss is designed to deliver the real-time pressure information utilities need to effectively manage their water distribution systems. Its robust construction, fast response time and precise output make it suitable for applications throughout a water

distribution network, from the pumping station and network control valves to secondary supply systems in high-rise buildings.

By delivering accurate, real-time data, the DST P140 enables utilities and operators to make informed decisions, optimize control strategies and extend infrastructure lifespan.



The DST P140 pressure transmitter offer:

A wide pressure range and overload capability – It supports measurement ranges of up to 50 bar (725 psi) with overload protection up to 200 bar, ensuring reliable operation in varying network conditions and during pressure surges.

High accuracy and fast response – It has a Total Error Band (TEB) within $\pm 3\%$ FS and a maximum response time of $< 2\text{ms}$, enabling precise real-time monitoring for effective pressure management.

A robust stainless-steel construction – Wetted parts in 304L/316L stainless steel provide excellent corrosion resistance, ideal for potable water and normal environmental conditions.

A sealed gauge pressure reference – This minimizes measurement drift due to atmospheric changes, ensuring stable readings.

IP67 protection and a wide temperature range – With its fully sealed IP67-rated housing and an operating range from -40°C to $+85^\circ\text{C}$ ambient, the DST P140 is suitable for diverse climates.

Full compliance with applicable regulations – It complies with key drinking water certifications such as WRAS, ACS and NSF/ANSI 61, ensuring suitability for use in municipal water supply networks.

The Aqua-drives for Intelligent Pressure Management

Efficient and reliable pressure control starts with intelligent pump operation, and Danfoss Aqua-drives are purpose-built to deliver exactly that. The Aqua-drives provide utilities with the dynamic, responsive pump control needed to maintain stable pressure across the entire network. This allows operators to reduce leakage, minimize bursts, and improve energy efficiency—without the need for costly infrastructure upgrades.

With robust hardware, intuitive water-focused software, and strong digital connectivity, the Aqua-drives ensure smooth, efficient operation in everything from primary pumping stations to complex multi-pump booster sets. By combining precise control with long-term durability, they help utilities safeguard their assets, reduce operational costs, and deliver consistent, high-quality water supply to communities.



The Aqua-drives offer:

Advanced pressure specific control functions – A dedicated AQUA feature set, including enhanced PID control and multi pump coordination, ensures stable set point pressure across varying demand conditions and helps minimize harmful pressure transients in the network.

Fast, accurate response for real time regulation – Its high performance control platform enables tight pressure bands at lower average pressure, improving supply reliability while reducing energy consumption and mechanical stress on pipes, valves, and pumps.

Robust design for water environments – With a wide power and enclosure range (IP20/21/54/55/66) and a platform built for harsh conditions, the Aqua-drives ensure dependable operation in pump rooms, booster stations, and near motor installations.

Grid friendly operation with harmonic mitigation – Harmonic mitigation solutions portfolio maintain near unity power factor and reduce harmonic distortion, supporting stable operation of critical pressure zones and compliance with emerging grid requirements.

Support for long term system resilience – Designed for maintainability and safe access, the platform helps utilities extend asset lifetime, reduce downtime, and maintain stable pressure performance throughout the distribution network.



Conclusion

Intelligent water pressure management holds the key to addressing the wide range of challenges facing the water utility sector. It enables municipalities to reduce leakage and wear-and-tear on their existing water distribution network, ensuring that more water gets into end users' faucets. Data collected through smart pressure sensors, like the DST P140 by Danfoss, also help utility managers to more effectively manage spikes in demand, avoid pressure surges and stress on the distribution network and detect leakages before they cause disruptions in service. And all of this can be accomplished within the existing infrastructure, without costly investments in new facilities or pipes.

For more information on how intelligent pressure management can benefit your water utility, visit the [Danfoss Sensing Solutions website](#).



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