HOLES IN THE BUCKET - FINDING LEAKS IN THE DISTRIBUTION NETWORK

Leakage is a major issue to the water industry. In the UK almost 3 billion litres of water leaked from the water distribution network each day from April 2019 to March 2020 according to Water UK figures. This is equivalent to 1,182 Olympic sized swimming pools of water daily. Each UK water company has its own leakage target based on how much it costs to reduce leakage in their distribution area and how much the saved water from reducing leakage is worth in financial terms, environmental terms and to meet customers' expectations. Leakage targets are approved by the regulator Ofwat and set at levels to keep water bills affordable. Targets are not the only driver for reducing leakage though.

Let's take Anglian Water (AW), the largest water and sewage provider in England and Wales, as an example. The area supplied by AW for example, has experienced large economic and population growth; 500,000 more households are supplied now compared with 1989. This growth is continuing and an estimated additional 104 million litres per day of water is required by 2045 (Figure 1). However, this area in the East of England already experiences pressures on water resources, for example from irrigation for farming, and there is little capacity for additional abstraction. It is a very dry region - at some points in the year, rainfall levels are comparable with Jerusalem. If water supply is not increased to meet demand and to sustain growth, then customers would likely experience water use restrictions, low pressure problems and supply interruptions. Anglian is currently working on a strategic pipeline interconnector project to link water sources in the North of the region into the supply network, and additional surface water reservoirs in the East of the region, but leakage reduction is also key to meeting demand.

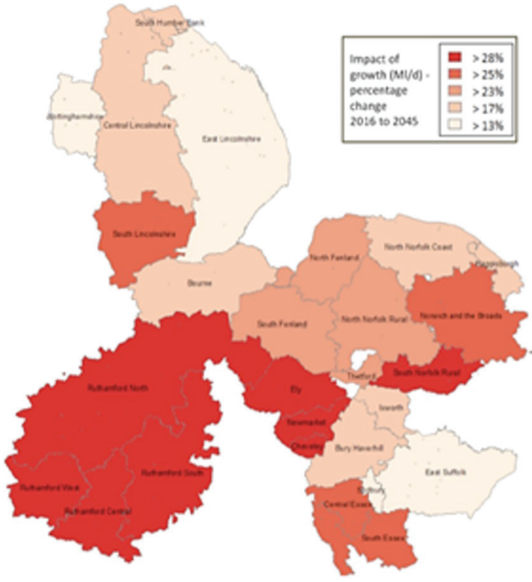

Figure 1: Area served by Anglian Water with projected increase in demand for water from 2016 - 2045

Anglian Water has an ambitious leakage reduction target of 52% compared with 1999 levels of leakage. Anglian Water engineers repair more than 45,000 leaks in the network each year, and there are 3 year rolling leakage reduction targets to keep the company on track. Another driver to reduce leakage comes from customer perception. "Our customers view leakage as a strong disincentive to adopting more water efficient behaviours", explains James Hargrave, Regional Leakage Operations Manager at Anglian Water. So, if Anglian Water can show that they are meeting leakage reduction targets this should help incentivise customers to also do their bit to save water at home. But how else can the steep target of 52% reduction compared with 1999 levels of leakage be met by 2045? What technologies exist to help meet this challenge?

Already 7,000 hydrophones fixed into the network cover about 15% of the supply network, to help detect leaks. Plus monitoring data from more than 250,000 smart water meters has also directly identified leaks. DMA flow is closely linked with seasonal patterns of water use and weather, with the highest peak in August 2021 (Figure 2). The flow peaks that would historically have prompted leakage investigations can therefore be explained as variation in consumption or use, which helps to avoid unnecessary call out work. Importantly, genuine leakage can be correctly identified. "Where night use differs from Base Net Flow, we can infer leakage and target leak repair work effectively," explains James Hargrave.

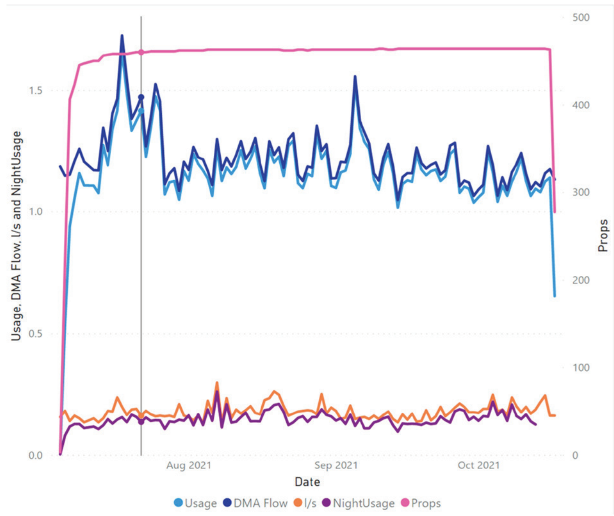

Figure 2: An example DMA with 100% smart meter coverage (© Anglian Water, 2021).

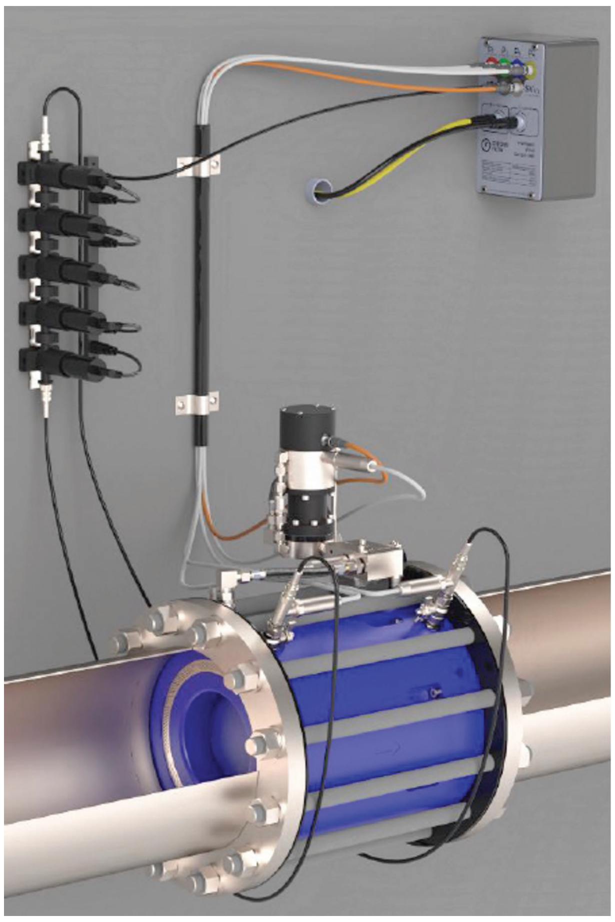

Figure 3: Intelligent valve system (© Oxford Flow, 2021)

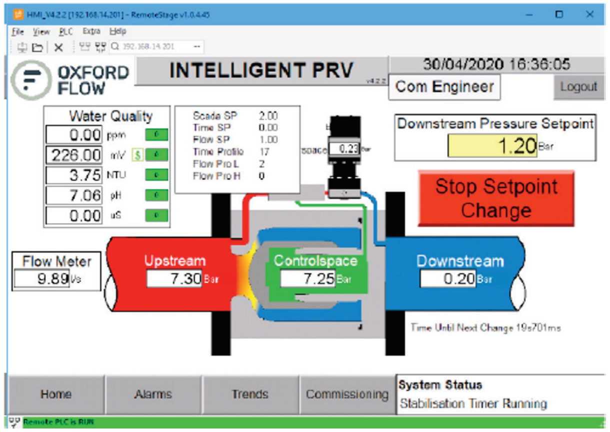

Figure 4: Dashboard to display pressure monitoring data (© Oxford Flow, 2021)

Figure 5: Battery powered flow and temperature clip on monitoring system (© Infersens, 2021)

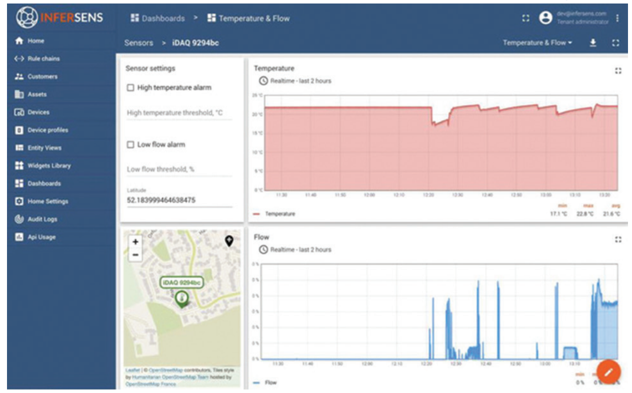

Figure 6: Dashboard for remote monitoring of flow (© Infersens, 2021)

Other indirect methods can also infer where leaks have occurred including 500 controllers for intelligent pressure management, covering more than 13% of the network. Also enhanced pressure monitoring can infer where leaks are happening. High frequency loggers are installed on critical mains and DMAs, and 1 hertz loggers elsewhere on the network.

New technologies for indirectly monitoring leakage include an integrated control system for water management incorporating a piston operated valve with automated control, pressure sensing, flow and water quality (Figure 3). The control unit collects signals and presents the data in a Modbus table, interacts with a high-resolution pilot actuator and uses a sophisticated algorithm to accurately control downstream pressure or flow rate. A setpoint can be controlled to plus or minus 0.05 bar with drift correction. Data is displayed in a dashboard where alarms can be set (Figure 4). The system can be integrated with SCADA networks. "By optimising pressure reduction, future leaks can be mitigated. Critical network performance data from the Intelligent Valve integrated with monitoring data from flow meters adds to understanding of flow in water networks and enables the identification of sections of pipe network with significant leaks," adds Tristram Broadbent, Principal Engineer, Oxford Flow.

An innovative, custom designed, lightweight water turbine made using 3D printing and laser cutting, can be added to generate power for the system, either in line or on a bypass line and avoid the need for mains power. This turbine could be used as a power source for other monitoring systems.

A new real time, fully automated, flow and temperature monitoring system has been developed which is AI enabled, low cost and non-intrusive – it simply clips onto the outside of pipes (Figure 5). The flow monitoring data is viewed remotely on a dashboard or Building Management System (BMS) (Figure 6), and automated alerts can be set up to provide early warning of flow rates that indicate the presence of a leak. The prototype product, developed with Innovate UK funding, was trialled by customers in 2020 and the beta product was piloted in late 2021. The UK product launch is due in 2022.

In the UK there is a novel opportunity for distributed real time monitoring in drinking water mains through the Fibre in Water project run by the Department of Digital, Culture, Media & Sport (DCMS). One aim of the project is to provide remote rural areas with improved access to gigabit Broadband services and 5G by installing fibre optic cables through the existing drinking water mains network. Simultaneously, the project will also enable the modernisation of the water industry by helping solve the challenge of the removal of the public switched telephone network (PSTN) which is due between 2021-2025. The project is earmarked to help address clean water leakage. Water and telecoms are both classed as Critical National Infrastructure and experience deployment challenges, but there are potential synergies that can be exploited through this project.

There are indeed some exciting developments on the horizon for leak detection. A full SWIG workshop on Leakage will be held on 2 February 2022 if you would like to learn more about how leakage can be tackled.

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A SWIG webinar on Leakage held on 2 February 2022 will be available to watch on a pay to view basis if you would like to learn more about how leakage can be tackled.

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