FRESH INSIGHTS INTO WATER NETWORK FAILURES

INFRASTRUCTURE GUIDE

GEOSPATIAL AI PROVIDES NETWORK OPERATORS WITH A NEW TOOL TO MANAGE NETWORKS THROUGH PROACTIVE RESOURCE & CAPEX OPTIMIZATION

Leaking pipes are both a financial and environmental concern for water network operators worldwide. In this article, we describe how Geospatial AI can assist in both reducing the cost and time to find leaks by prioritising where to inspect the network based on its likelihood of failure, optimizing both ground resource and capital expenditure, such as acoustic logger procurement and pipeline replacement.

Leakage, particularly from networks in water-scarce areas, is an important issue affecting water companies and their customers worldwide. Global estimates from the International Water Association (IWA) suggest 126 billion m^3 of water is lost every year at a cost of $39 billion.

The importance of reducing water losses for customers is evident especially in parts of the world facing water supply challenges. But leaky pipes have a significant impact on both water companies and consumers alike. With high levels of 'non-revenue water' (NRW) – defined as the difference between the amount of water put into the distribution system and the amount of water billed to consumers – water network operators face excessive operational costs, service interruptions, and customer dissatisfaction with costs that are often passed on to customers.

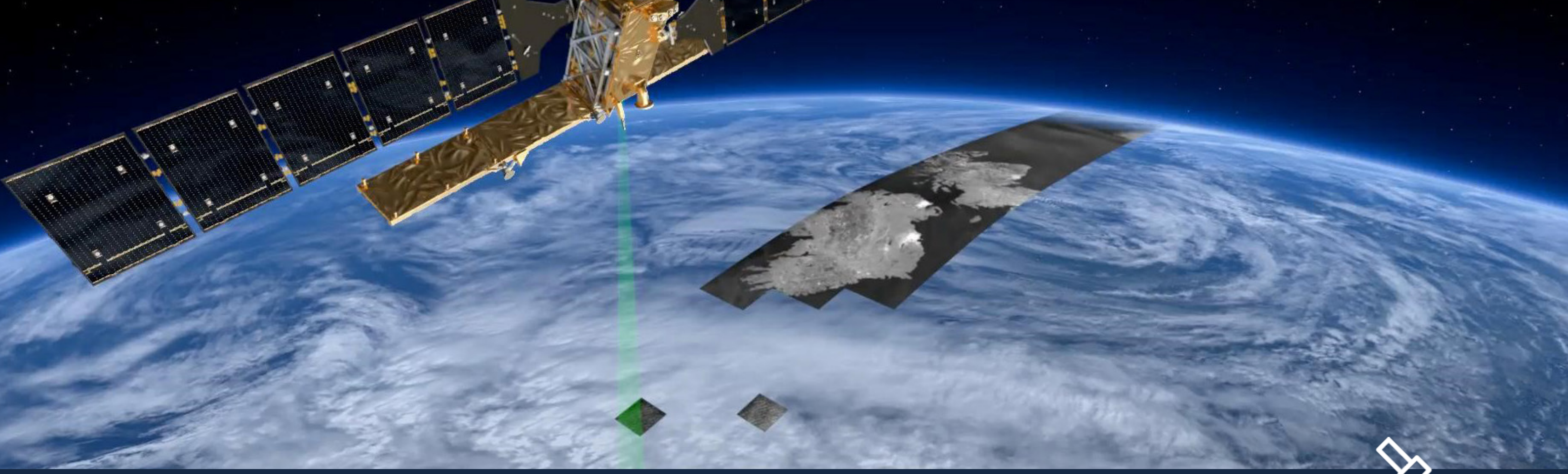
In response to this situation, the IWA Water Loss Specialist Group has established a set of Good Practices to control water loss. But many operators are keen to do more, turning to innovative new technologies to reduce costs, increase efficiency and improve reliability.

CHALLENGES IN REDUCING WATER LOSS

A prominent example of a technology actively reducing water loss is IoT sensors such as acoustic loggers. Acoustic loggers are increasingly being deployed in the field to both detect and locate leaks. Temporary and mobile loggers are well established, but only recently has the technology come down in price sufficiently to allow mass deployment of permanent loggers. This has prompted many companies to invest in these devices in response to the costs in terms of both time and money involved in regular sweeps of their system, which even when split into district metered areas (DMAs) can take several days. In fact, these operational costs are so high that companies need to wait until the marginal cost of leak detection equals that of water, often meaning several leaks need to accumulate before action is taken on a given DMA.

Loggers localise potential leaks down to a few yards and reduce the time it takes to pinpoint a leak from days to a few hours. This can dramatically reduce operational expenditure. However, given their cost and the fact that they need to be installed regularly across the network, sometimes every ~150 yards, operators are forced to decide between significant capital outlay in deploying loggers throughout their entire network, or placing them strategically within a network; with many only deploying them in areas of recurrent burst. For those who choose the second option, without current information on the sections of the network that are at high risk of failure, often these sensors are not positioned where they need to be.

Furthermore, loggers are effective in helping operators react to leaks. But they offer no information on preventing leaks from happening in the first place. Currently, prevention measures include replacing or upgrading ageing pipelines, controlling water pressure and scheduled ground surveys. However, these measures have proved insufficient for most operators, with leakage rates largely remaining stable despite best efforts.



GEOSPATIAL AI TO QUANTIFY PIPELINE FAILURE RISK

One cutting-edge approach that can assist operators in meeting these challenges head on is Geospatial AI. Geospatial AI identifies the conditions under which network failures occur. It combines local environmental data such as soil, weather and topography, regular insights derived from Earth-observing satellites, with data on pipeline attributes, such as material, age, depth and diameter. Together, these data are integrated into a sophisticated risk model that considers both pipeline characteristics and relevant aspects of the environment in which the pipeline resides.

These data are then calibrated against historic failure event data in the model, which help train and validate machine learning algorithms to produce a risk analysis. With all this information in hand, machine learning techniques are applied to current data to recognise patterns and produce insights. The resulting analytics quantifies the likelihood of failure across a network.

The information Geospatial AI provides has significant real-world impact. Taking just two years of historic data to train Geospatial AI algorithms, areas of the network more likely to be at risk from failure can be prioritized for investigation to enable efficient asset management. As a representative example, Rezatec reports that by using a Geospatial AI approach, typically it can highlight the 30% of the network where a water company can expect 70% of leaks to occur. The degree of optimization achieved can be higher and depends upon the quality of the data supplied by the customer.

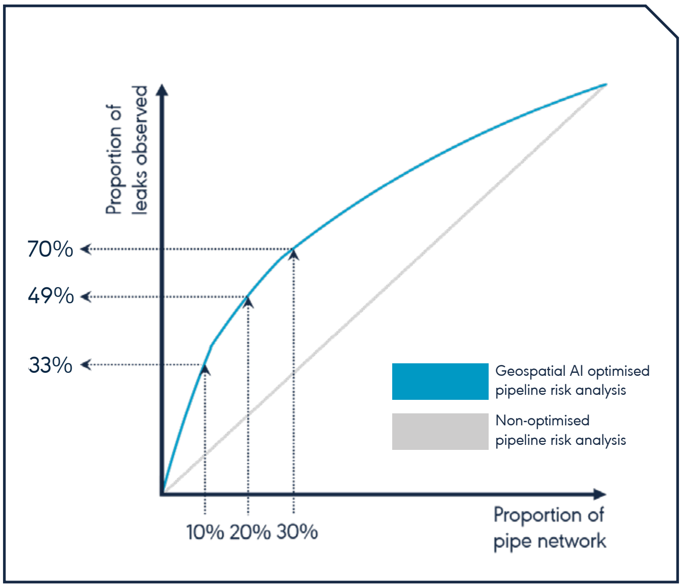


Figure 1: Prioritization and optimization of resources to manage pipeline network assessment

Though Geospatial AI does not provide information on the precise location of water losses or leakages in a water network, the insights it does offer are powerful and tangible. Geospatial AI is an innovative method for proactive pipeline risk management and strategic investment planning, generating crucial information on how to optimize the deployment of resources, repair and maintenance, and capital expenditure based on the likelihood of failure at the whole network level or DMA level. Furthermore, by regularly updating contemporary data, risk hotspots can be tracked temporally to allow rapid identification of high-risk sections.

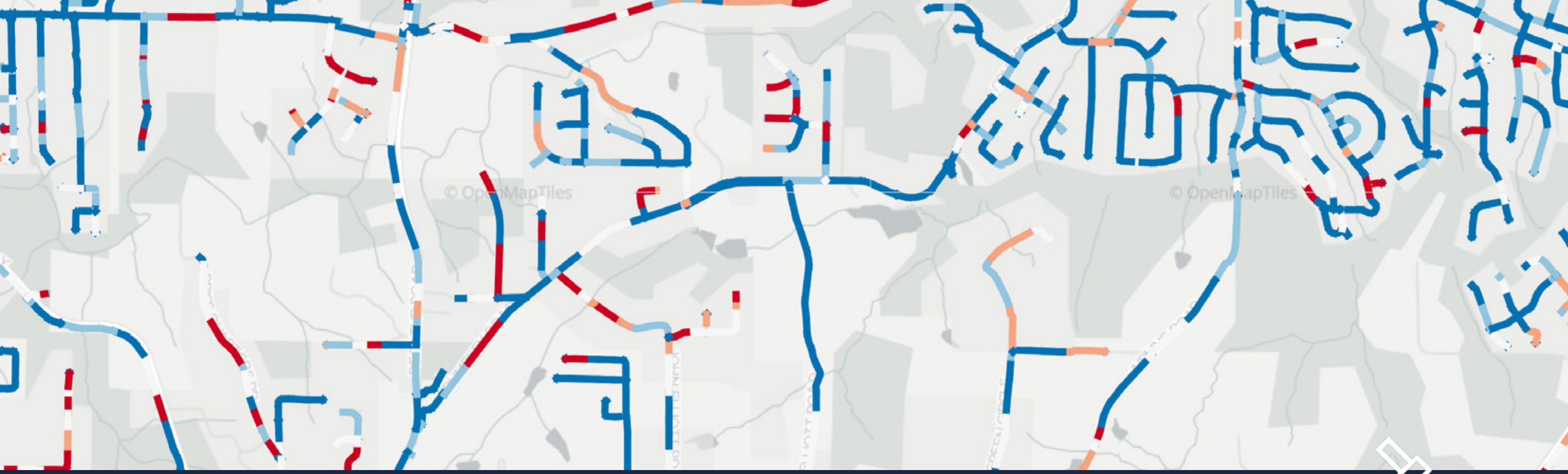
FIND, FIX AND PREVENT

The insights Geospatial AI provides have a number of practical applications. For instance, survey prioritisation. Data analytics can produce failure risk maps and priority risk zones that are regularly updated and show the probability of failure of all network assets. Operators can use these insights to trace leakages, plan inspections or prioritise maintenance, optimizing in-field surveys in terms of both time and cost, and ultimately allowing early or even preventive interventions that reduce leakages and water loss.

Another application of Geospatial AI is it can be used as an efficient and fast way of figuring out the best disposition of acoustic loggers for optimal coverage of a given water network, identifying high-risk assets so that loggers can be installed selectively. Moreover, these decisions can be based on granular data about pipe material, size and consequence of failure.

This maximises the effectiveness of logger deployment, allowing network operators to place them in spots with the highest risk of failure. And it also allows operators to invest in fewer loggers, thereby minimising not just capital expenditure but also operational expenditure.

In real terms, the total cost of acoustic loggers is much more than the upfront ~$600 purchase price. Telecommunication connectivity and software licensing add annual fees, and loggers need to be maintained every ~5 years when they come to the end of their battery life. As a result, many network operators see a high total cost of ownership and poor ROI from acoustic logger deployment.



EFFICIENCY THAT BENEFITS BOTH OPERATORS AND CUSTOMERS

Identify problem areas with the highest likelihood of failure

Optimise the deployment of leak detection & maintenance teams

Identify the 30% of your network where you can expect 70% of leaks to occur

Assuming that the costs are proportional to the length of time taken to detect the leaks and/or to the proportion of the pipe network that needs to be checked (and hence the number of detectors required to be deployed), then detection costs can be reduced by more than 60% through Geospatial AI. For a standard 6,000 miles of mains network (2,500 mile of which DMA), a 60% cost reduction equates to a $11 million saving over five years ($2.2 million p.a.) just from reducing the number of loggers required.

Analysis can be further improved by incorporating additional geospatial datasets and Earth-observation satellite data in order to identify the specific conditions under which network failures occur, mitigate high consequence risks, and digitize general knowledge and understanding of the network.

This information can be used by key stakeholders to help alleviate environmental impact, prioritise pipeline repair and maintenance around other utility works, and assess and manage risk to vulnerable buildings and other infrastructure assets. Additionally, water utilities can better manage costs associated with standard service measures such as interruption of supply, disruption to traffic and internal flooding.

At a time of growing demand and scarcity of freshwater resources in many parts of the world, technologies like Geospatial AI can help reduce water losses in networks around the globe, with benefits for operators and customers alike.

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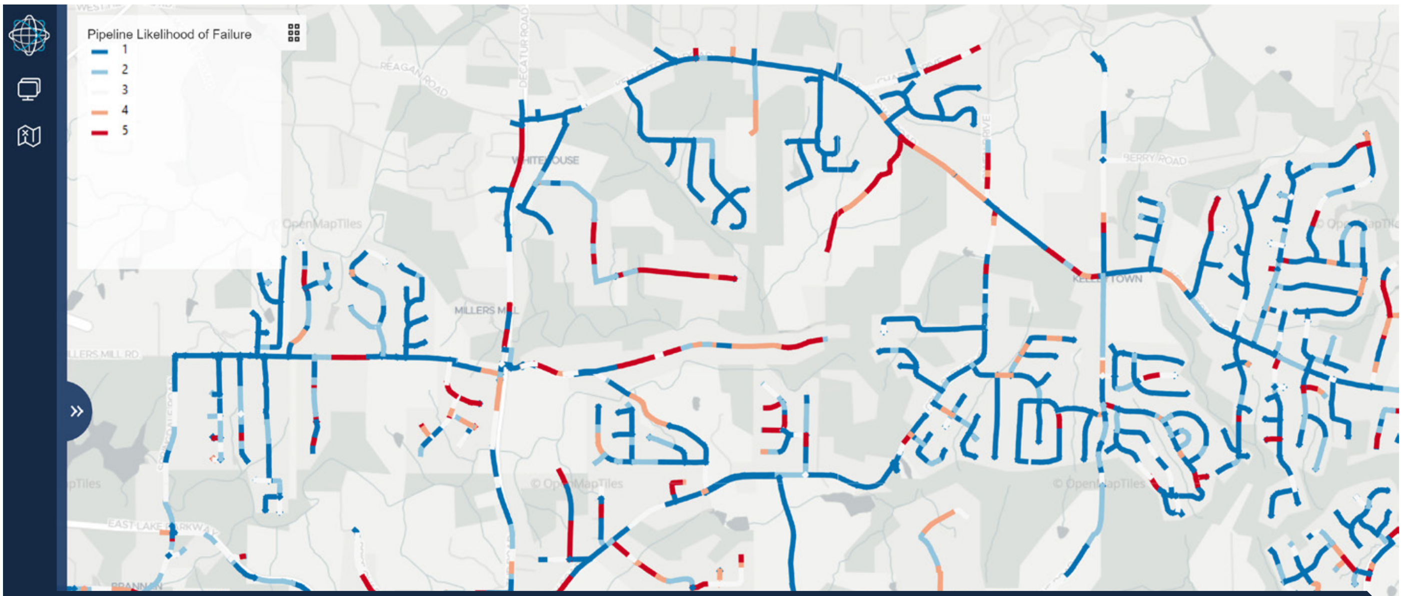

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