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Asia Water Forum 2022
8-11 August 2022 • Online

Side Event

S4A: Using technology to reduce
leakage in water distribution networks

Schedule: 8th Aug 2022 - 3:30 pm



Leakage Management Benchmarking

Business Consulting



ADB

1.

Leakage Management Benchmarking

PROGRAM OVERVIEW



Program Overview – Objectives



Objectively assess performance and maturity in non-revenue water management



Access and share international innovation and best practice



Customise improvement pathways for participants





Program Overview – Data Sources

Part 1: Comparing practices in calculating and managing the Non-Revenue Water (NRW) Balance

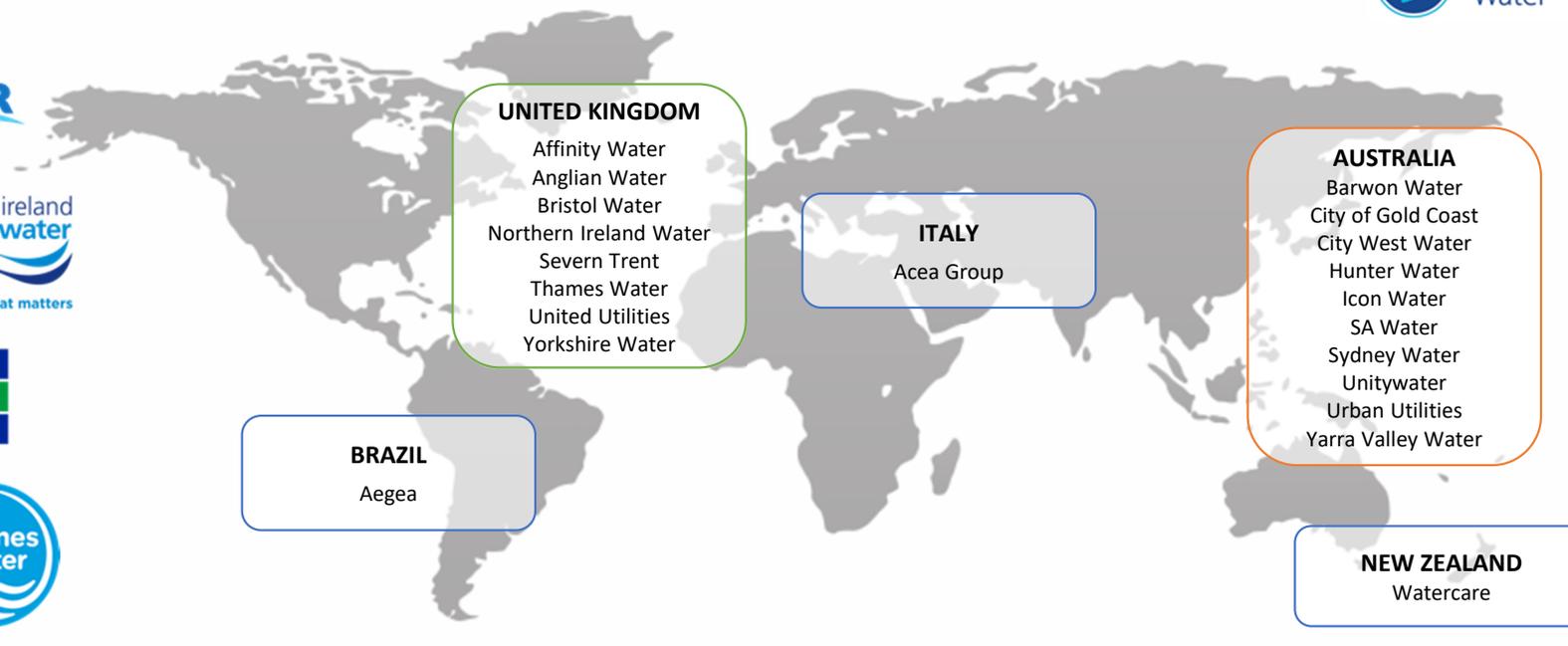
Part 2: Comparing practices in utilisation of the Four Pillars of Leakage Management

System Input Volume	Authorised Consumption	Billed Authorised Consumption	Billed Metered Consumption Billed Unmetered Consumption	Revenue Water
		Unbilled Authorised Consumption	Unbilled Metered Consumption Unbilled Unmetered Consumption	
	Water Losses	Commercial Losses	Unauthorised Consumption Customer Meter Inaccuracies and Data Handling Errors	Non Revenue Water
		Physical Losses	Leakage on Transmission and Distribution Mains	
			Leakage and Overflows from Storage Tanks	
			Leakage on Service Connections up to the Customer Meter	





Program Overview – Peer Group to date



- UNITED KINGDOM**
- Affinity Water
 - Anglian Water
 - Bristol Water
 - Northern Ireland Water
 - Severn Trent
 - Thames Water
 - United Utilities
 - Yorkshire Water

- ITALY**
- Acea Group

- AUSTRALIA**
- Barwon Water
 - City of Gold Coast
 - City West Water
 - Hunter Water
 - Icon Water
 - SA Water
 - Sydney Water
 - Unitywater
 - Urban Utilities
 - Yarra Valley Water

- BRAZIL**
- Aegee

- NEW ZEALAND**
- Watercare



Data and insights have been provided from twenty-one (21) utilities across **Australia**, **Brazil**, **Italy**, **New Zealand** and the **United Kingdom**.





Program Overview – Best Practice Workshop


 Leakage
 Management
 Benchmarking
**BEST PRACTICE
 WORKSHOPS**
 28-29 Sep 2021

 Let's Solve Water

- Workshops included participants from 21 utilities (approximately 100 x attendees)
- Best Practices shared from Australia, Malaysia, New Zealand and the United Kingdom
- 18 technology and 40 process Best Practices compiled into a compendium, accessible to all participants



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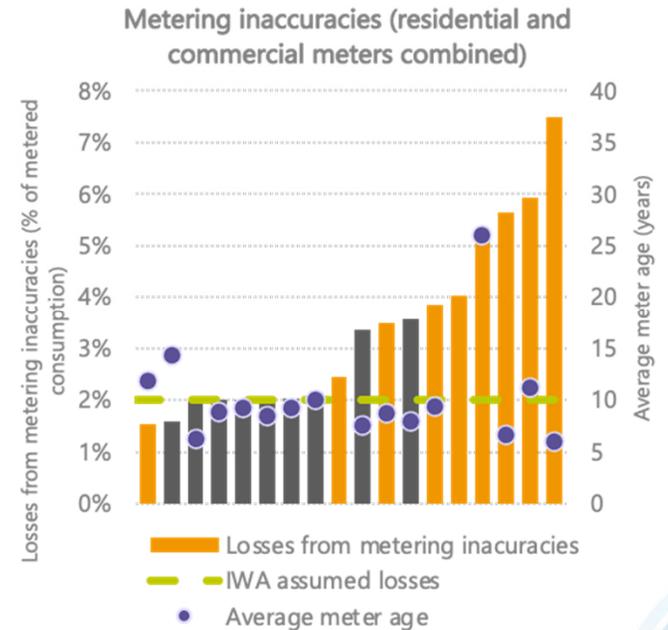
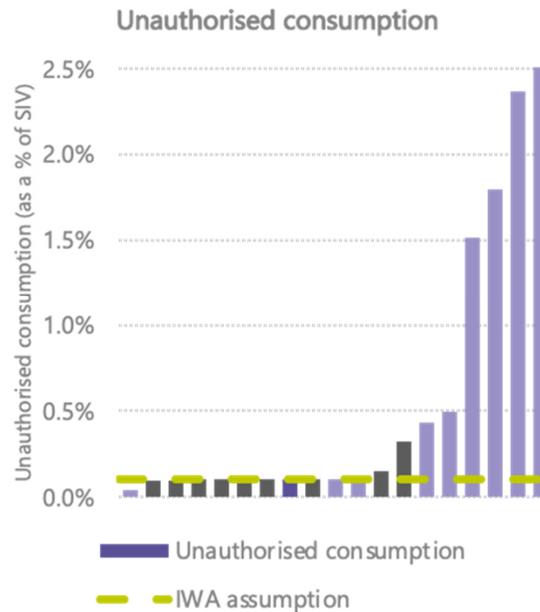
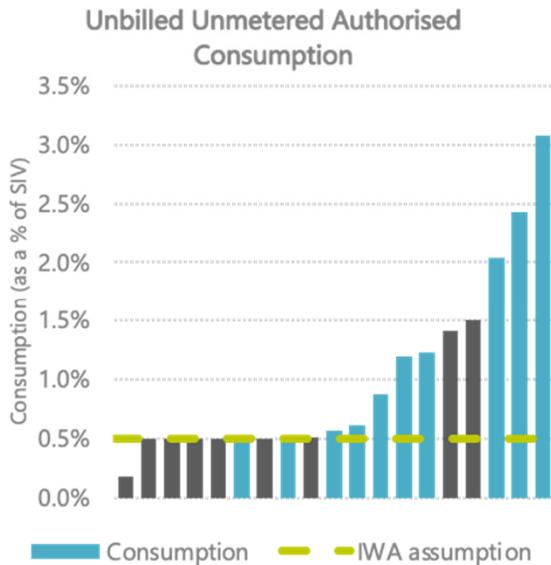
Leakage Management Benchmarking

PROGRAM INSIGHTS AND BEST PRACTICES



Program Insights – IWA Balance

- Varying levels of confidence in the accuracy of NRW values for Unbilled Authorised Consumption and Unauthorised Consumption.
- Many Australian utilities use IWA assumptions whilst UK utilities use internally developed figures (due to regulatory reporting requirements).
- IWA assumes 0.1% of the system input volume can be assigned to theft – measured figures are much larger than that!



Case Study – Yorkshire Water, UK

Network: Ofwat Utilities (England and Wales) as presented by Yorkshire Water **Services:** Integrated water/wastewater, bulk water **Connections:** ~1.2m **SIV:** ~456 GL

About: The economic regulator of the water sector in England and Wales (**Ofwat**) requires that water companies quantify all components of the standard **International Water Association (IWA) water mass balance**. This process typically results in companies using figures higher or lower as applicable than the standard IWA figures for Unbilled Unmetered Authorised Consumption (0.5% of SIV), Unauthorised Consumption (0.1% of SIV) and Customer Metering Inaccuracies (2% of residential metered consumption). Yorkshire Water considerations are captured in the **Table** below. **The Ofwat approach requires that:**

- Any imbalance (positive or negative) must be reconciled
- Imbalance must be <5% of distribution input
- Reconciliation must take place to produce regulatory reported components (e.g. Per capita consumption, Leakage)

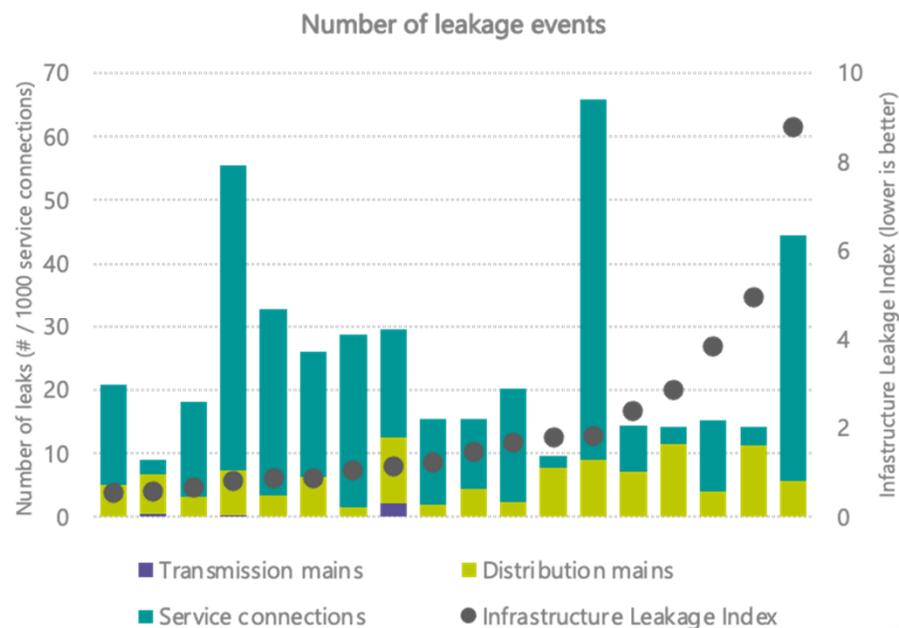
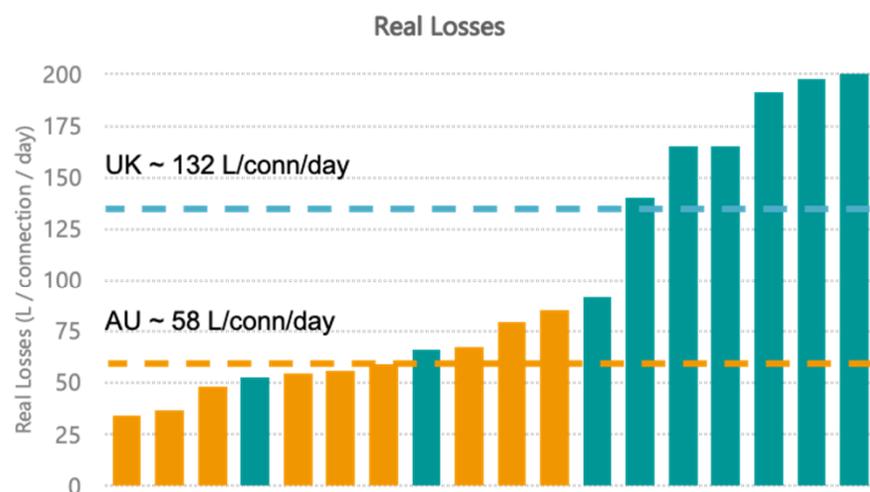
Table: Bottom up NRW balance considerations at Yorkshire Water

Unbilled Authorised Consumption	Apparent Losses	Current Annual Real Losses
<p>Unbilled Metered Consumption</p> <ul style="list-style-type: none"> • Company own use at sites • Free metered supplies to steelworks • 3rd party metered standpipe usage <p>Unbilled Unmetered Consumption</p> <ul style="list-style-type: none"> • Free supplies – e.g. water donations to vulnerable customers • Firefighting usage – assumptions using quarterly data from 4x regional fire services • Free unmetered supplies to farms – assumptions made regarding usage & PCC • Operational water usage – routine and proactive flushing, reservoir sampling and cleaning • Losses from 3rd party bursts 	<p>Unauthorised Consumption</p> <ul style="list-style-type: none"> • Occupied voids incl. internal losses • Residential – c.30% vacant, c.45% occupied • Businesses – conservative estimates for high-risk voids • Illegal connections – connected properties not in billing system • Illegal hydrant use <p>Customer Metering Inaccuracies</p> <ul style="list-style-type: none"> • Meter under registration (MUR): <ul style="list-style-type: none"> ○ WRC independent study to assign MUR% across cohorts of meters (size, consumption, age) ○ MUR figure for each consumption type (residential, business) 	<p>Service Reservoir leakage</p> <ul style="list-style-type: none"> • Annual drop tests, minor component <p>Trunk Main leakage</p> <ul style="list-style-type: none"> • Representative sample of trunk mains <ul style="list-style-type: none"> ○ Daily flow balances available ○ Scaled to full network with statistical treatment of outliers <p>DMA leakage</p> <ul style="list-style-type: none"> • Area flows measured at night, with deduction for: <ul style="list-style-type: none"> ○ Residential consumption (using sample) ○ Business consumption (logged users, plus sample) • Includes supply pipe leakage (between service pipe and property boundary)

Benefits: Water balance reconciliation drives UK water companies to account for NRW and has driven companies to undertake 'Data Improvement' programmes to improve the robustness of their water balances

Program Insights – Real Losses

- Younger asset base results in lower Real Losses for Australian utilities.
- Some using the UK Background and Bursts Estimates (BABE) Model to estimate real losses.
- Leakage events are predominantly in services, where premature failure of material and little knowledge of these assets has increased event numbers for some utilities.





Case Study – Unitywater, Australia

Network: Unitywater **Services:** Water/wastewater, retailer **Connections:** ~260k **SIV:** ~66GL

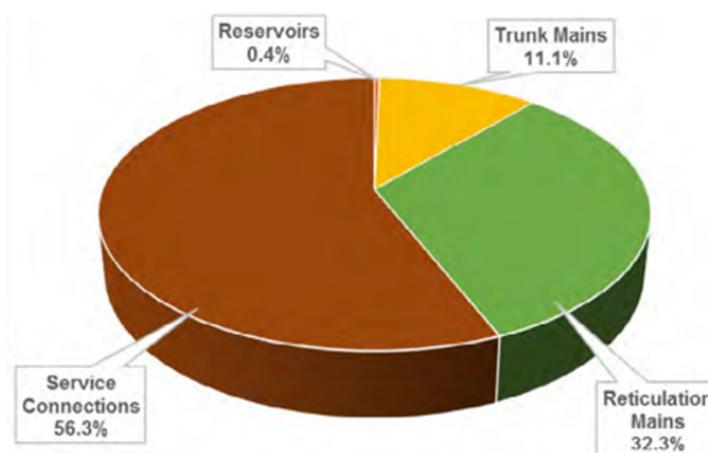
About:

Traditionally, water utilities have used rough estimates for determining how their Real Losses are distributed across their assets (e.g. using industry-standard distributions, or estimating a distribution based on length of mains and/or burst rates). However, the distribution of Real Losses across different assets is dependent on a large number of variables and can vary significantly between utilities.

Unitywater undertook a bottom-up analysis of leakage across their assets (reservoirs, trunk mains, distribution mains, and service connections), where leakage was classed as (1) reported leakage (i.e. visible leaks reported to the utility); (2) unreported leakage (i.e. detectable only by active leak detection (ALD)); and (3) background leakage (small, undetectable leakage that persists until it worsens to the point of being detectable by ALD.

Unitywater ensured that operational crews were recording the estimated reported leakage and set out to determine the level of unreported leakage using significant levels of ALD. The results of this significantly changed Unitywater's understanding of which assets contributed the most to Real Losses. E.g. Distribution mains contribute 44% of reported leakage by volume but only 32% of leakage volume in the bottom-up analysis (see Figure).

Figure: Unitywater Real Losses from Various Components of Water Supply Network



Benefits:

- **Improved understanding of where Real Losses are occurring.** This is due to better information about smaller leaks rather than using industry-generalised assumptions of where losses are occurring or only using reported leakage.
- Greater understanding of the water supply network to help **inform utilities in their leakage management decision-making.**

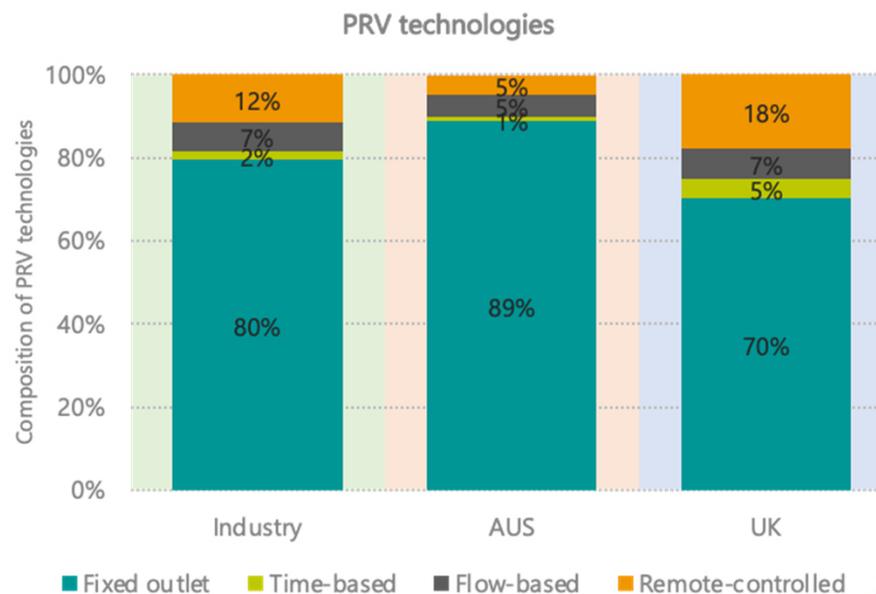
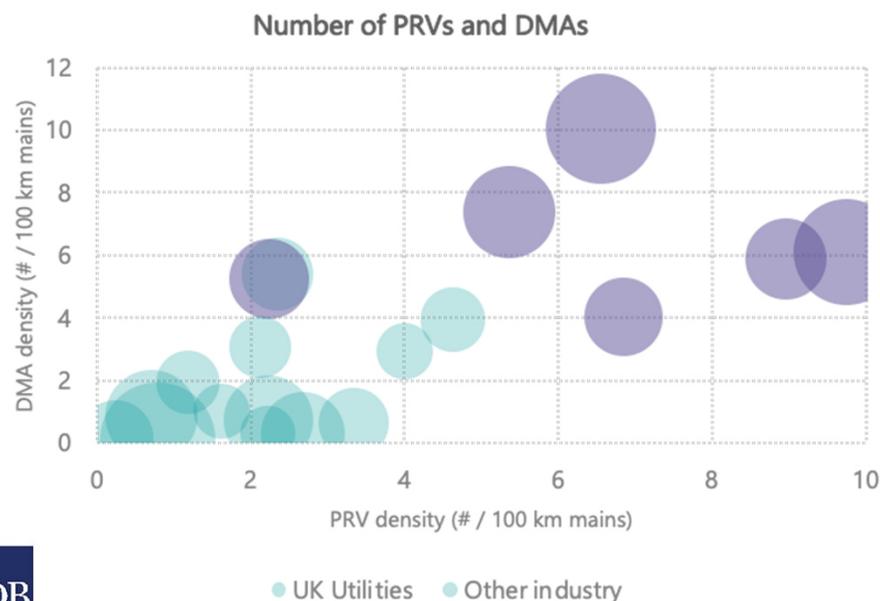
Considerations:

Significant active leak detection is required across the majority of the network in order to determine an accurate estimate of unreported leakage.



Program Insights – Pressure Management

- UK utilities generally have a history of higher investment in Pressure Management than Australian utilities, which is evident in consideration of their density of PRVs and DMAs.
- UK utilities have higher applications of technology (e.g. remote-controlled PRV technologies), with investment yet to progress beyond mostly fixed outlet PRVs within Australian utilities. The UK companies have cited performance improvements through using remote-controlled PRVs to respond to emergency requirements and in managing fire flows.



Case Study – Thames Water, UK

Network:

Thames Water

Services:

Integrated water/wastewater

Connections:

2.5 million

SIV:

953 GL

About:

Thames Water has made extensive use of pressure management over the years to optimise pressures to minimise leakage and bursts whilst ensuring customers are provided with suitable water pressure. It now has **over 1,000 pressure management schemes across its water supply area.**

As a standard Thames Water now install **remotely controlled, “closed loop” systems** (refer Figure). This ensures that **the outlet pressures at the Pressure Reducing Valves are continuously adjusted to address changing customer demand (night and day, winter and summer) to keep pressures at their optimum.**

Systems installed vary in size and complexity, from **single feed PRV systems of less than 500 properties, up to large multi feed systems with over 400,000 customers.**

For most schemes a single pressure control location is used. This is normally selected to be at the location of the highest properties in the pressure management area, although in areas of larger head losses the control point is located to directly manage the properties which can experience the lowest available pressure.



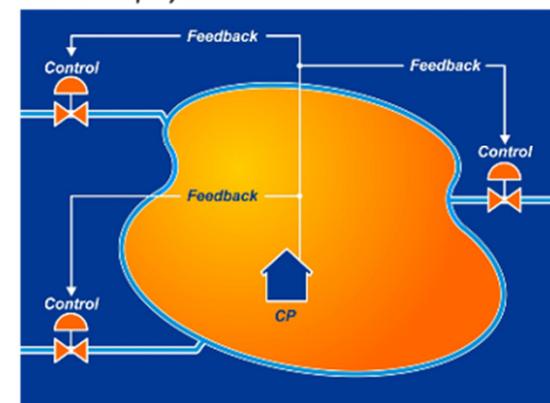
Benefits:

- Remote-Controlled Pressure Management can be used to **optimise pressures to meet varying customer demand.**
- Remote-Controlled Pressure Reducing Valves reduce need for re-optimisation, freeing up time for more proactive tasks for field workforce.
- Remote-Controlled Pressure Management enables water utilities to **respond quickly to changing pressure requirements e.g. fire flow to meet the requirements in an emergency situation.**

Considerations:

- Understand the failsafe setup of the pressure management scheme if communication with the control point is lost, e.g. reverting to time profile.
- Remote-controlled PRV's open up to “feed” leaks. Therefore more reliance is placed on the monitoring of district meter flows to manage leakage.

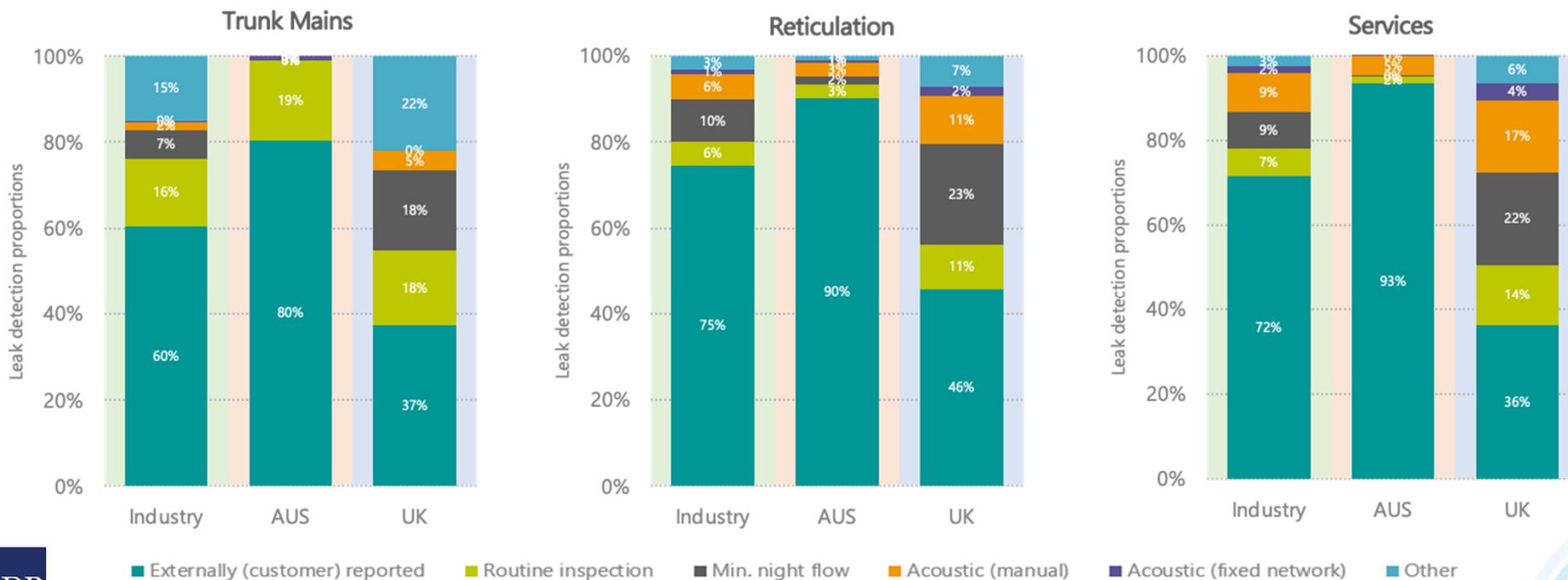
Figure: Sample layout for remote-controlled closed loop system





Program Insights – ALD

- UK utilities generally adopt a much higher penetration of technology for the identification of Transmission, Distribution and Service Connection assets.
- Australian utilities have a higher reliance on customer reporting of leaks in comparison to UK peers, with limited deployment of technology.



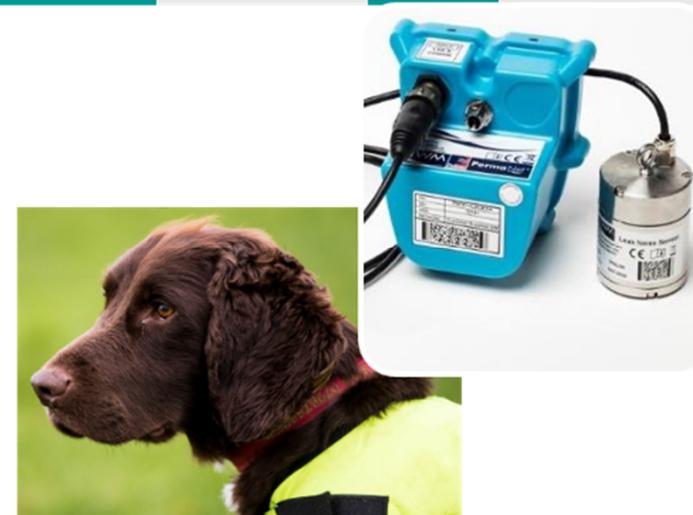
Case Study – United Utilities, UK

Network: United Utilities **Services:** Integrated water/wastewater, retailer **Connections:** 2.9 M **SIV:** 660 GL/yr

About: United Utilities (UU) was looking for a **step-change improvement in order to meet a target of 15% reduction in leakage**. A multi-pronged approach was implemented, beginning with studies, pilots, and trials to inform UU's strategy. This included **fast logging for night use, acoustic loggers, satellite technologies, sniffer dogs, and remote pressure control**.

A significant part of UU's strategy was the use of acoustic leak detection. As part of Phase 1 (2019), **46,000 loggers were installed in select DMAs accounting for 10% of UU's network** (refer TP4 in Appendix C for technology). In 12 months, 10,000 alarms were analysed and 7,281 leaks were raised (accounting for 24% of leaks in the DMAs with loggers). **This was accompanied by the development of a formal Leakage Apprenticeship Scheme, and hiring of over 20 new apprentices.**

Phase 2 of UU's plan includes the deployment of more acoustic loggers, the development of automated analysis of alarms, and automated detection of leak size. UU have noted that maintenance of the loggers and management of data from the loggers is of critical importance to the continued success of this program.



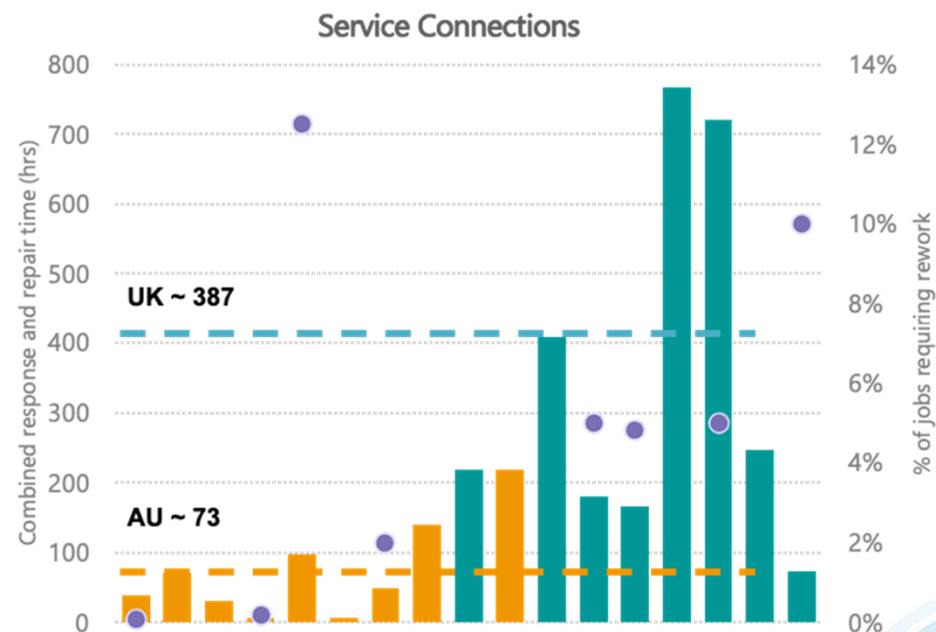
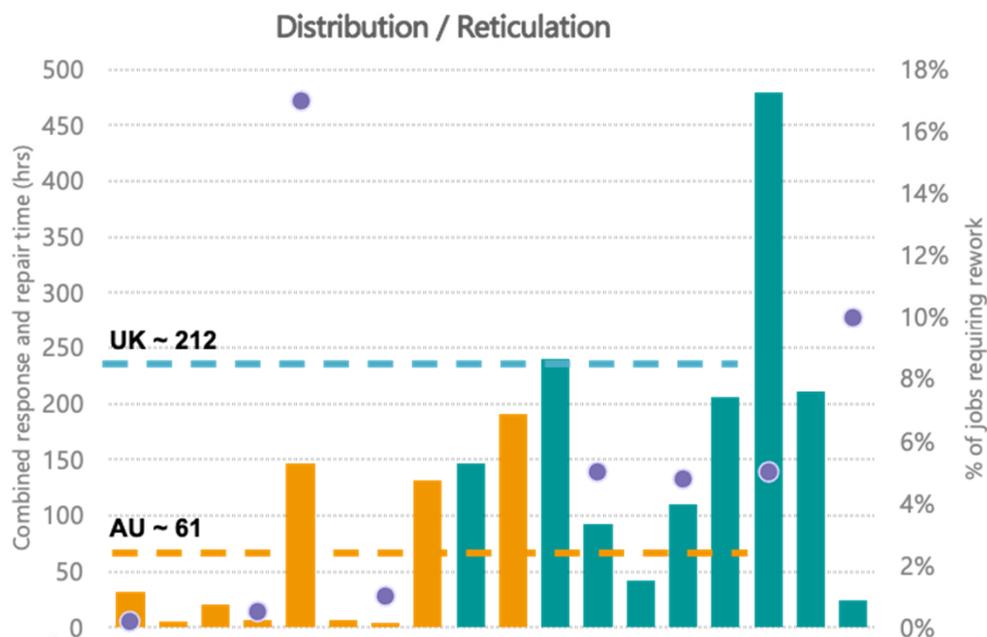
- Benefits:**
- **7,281 leaks raised (from 10,000 alarms)**
 - **Acoustic loggers accounted for 24% of detected leaks** (in DMAs where the loggers were installed)
 - **12 ML/d reduction in DMA leakage (~14% in logged DMAs) (expected to increase by an additional 17 ML/d in Phase 2 of the project)**
 - 12% of DMAs are now below their historic minimum leakage levels.

- Considerations:**
- Significant investment required to get enough acoustic loggers
 - Additional technical training is required for operational staff



Program Insights – Speed & Quality of Repairs

- Australian utilities adopt high prioritisation of mains and services leak approaches, with repair performance reinforced through tight contract management of outsourced service providers, leading to high quality and very quick response and repair times.
- Many UK utilities noted significant delays encountered in arranging access to assets with third parties.



Case Study – City West Water, Australia

Network:

City West Water

Services:

Water and wastewater retailer

Connections:

~320k

SIV:

~115 GL

About:

In response to the Millennium Drought (1997-2009), City West Water undertook a variety of initiatives to optimise contract management processes and associated leakage response prioritisation in order to enhance responsiveness and speed in rectification of network leaks.

The terms of City West Water's maintenance contract renewal included a **re-prioritisation of all leakage events across the network (e.g. transmission/distribution mains and service connections) to the highest two levels of priority in response (i.e. P1 and P2 in alignment with the Essential Service Commission's definitions).**

Burst and/or leak work orders are received into City West Water's maintenance delivery mobility system, then jobs dispatched to the maintenance contractor's supervisor for assessment and actioning for repair. **The maintenance contract has strong KPIs to drive and monitor commitment to the prioritisation of leakage repairs.**



Benefits:

- 1. Working together to achieve efficiency gains**
2. Shared mobility system to enable smooth dispatch and assessment process
- 3. KPI applied to prioritise leakage repairs and reduce leak run time**
4. The development of KPIs enabled appropriate resource level to meet the activities requirement.
- 5. Minimize water loss and non-revenue water**
6. Achieve better customer outcomes

Considerations:

Bedding down the new contract model to understand the KPI implications in the first year of the contract should be a priority. Accommodating increased field activities (e.g. dry conditions lead to high level of activities) require balancing resources and activities. Good contract management system is key to manage the contract performance, including continuous improvement, flexibility and agility of resources.

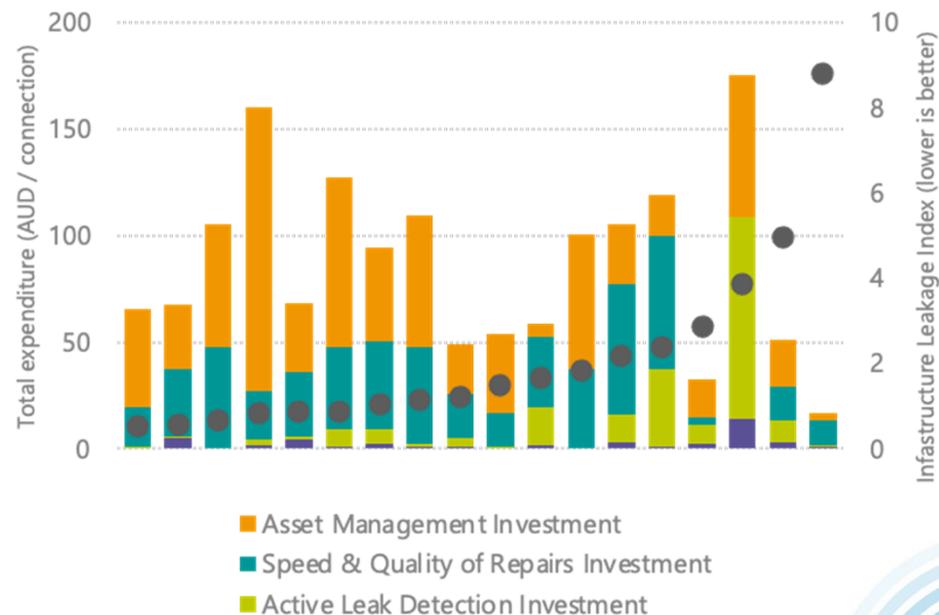
Program Insights – Investment

- Asset Management (distribution mains renewal) has considerably higher expenditure in Australia than the UK.
- UK utilities have typically invested considerably more historically in the development of DMAs, and installation of PRVs and ALD than their international peers.

Distribution Mains Renewals



Leakage Management Pillar Investment (TOTEX) vs. ILI



Case Study – Unitywater, Australia

Unitywater

Services: Water/wastewater Retailer

Connections: ~300k

SIV: 66 GL/yr

About:

In response to ambitious NRW reduction targets set by Unitywater management, a **10 year System Leakage Management Plan (SLMP)** has been developed by Unitywater to provide strategic direction in systematically reducing the Total Losses in their network. The SLMP focuses on 9 identified pillars of leakage management defined by Unitywater (Figure 1).

The key measures proposed for the reduction of real losses are: **increase the Active Leakage Detection on reticulation mains to 750km/quarter, additional trunk main active detection using acoustic loggers, apply advanced pressure management on 50 DMAs by using flow modulation with three-point data loggers, and a planned service mains replacement program.**

The key measures proposed for reduction of apparent losses are: **replacement of 12,000 (20-25mm) customer meters/year, replace top 8% commercial users with electronic meters, roll out of the digital metering program, and improving accuracy validation of the bulk flow meters.**



Benefits:

- The SLMP provides a **ten-year investment plan**
- The plan predicts that a **32% additional investment profile will reduce real losses by 35%.**
- The investment has a **positive result within a ten-year NPV (Figure 2)**
- **Real Losses will reduce from 57.6 to 37 L/conn/day**
- Apparent Losses will reduce by 0.52% over the period of ten years
- The effectiveness of the implementation of the plan will be measured by the semi-automated quarterly and annual water balances.



Figure 1: Unitywater 9 Pillars

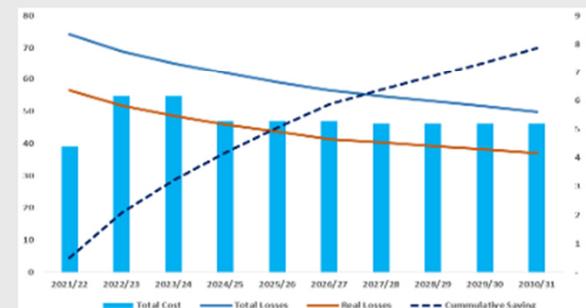


Figure 2: SLMP Investment Plan



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