24th ANNUAL
LEAKAGE CONFERENCE

4 – 5 DECEMBER 2023
BIRMINGHAM & LIVESTREAM

Organised by
lodestar

Media partner
THE WATER REPORT
POLICY | REGULATION | COMPETITION

Welcome back

Bob Taylor

CEO

Portsmouth Water

Resilience, at what cost?

Managing water infrastructure assets as we aim for zero supply interruptions. An interactive session led by

Dr Sam Fox

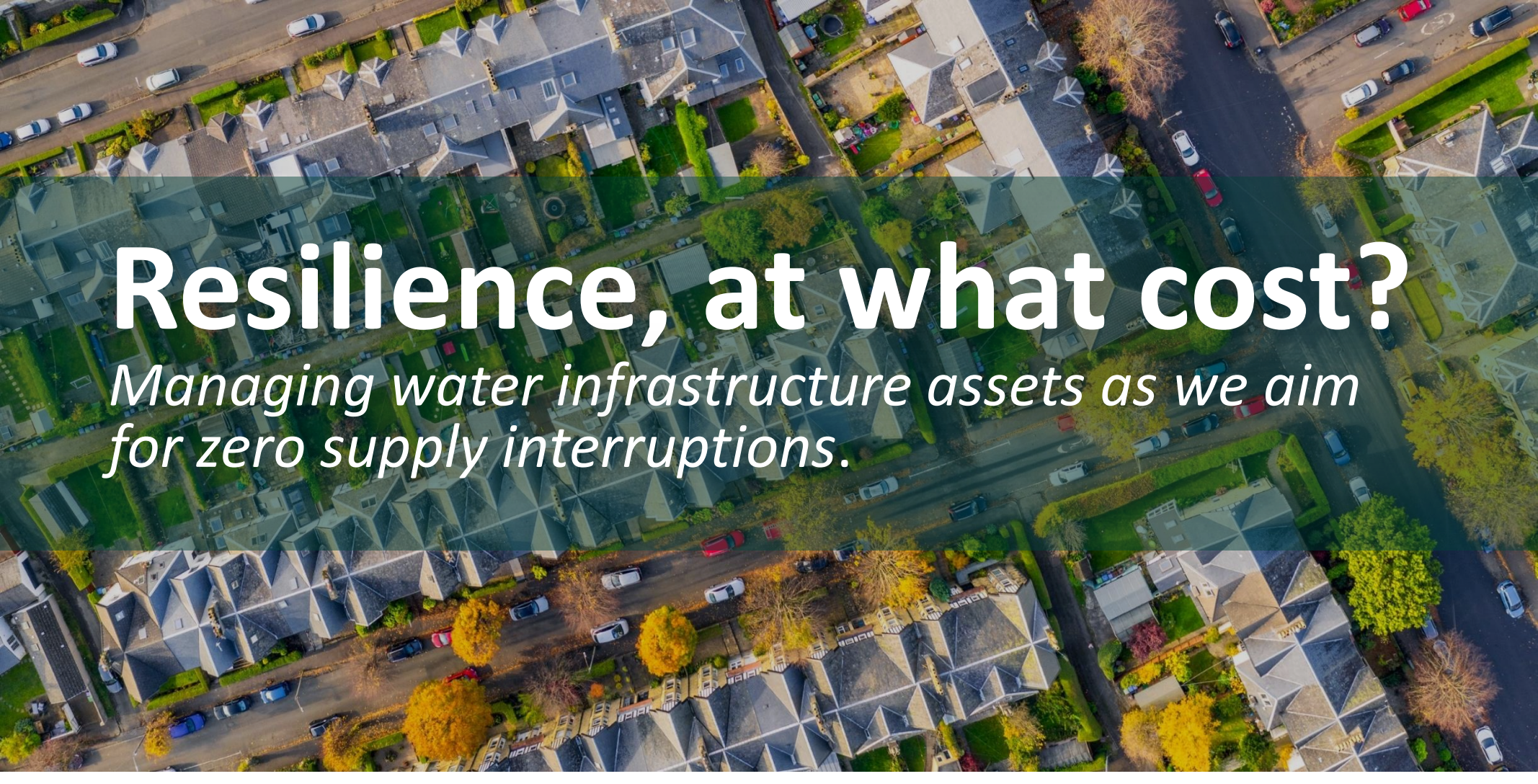
Head of Integrated Network Strategy

United Utilities

John Birkhead

Water Network Strategy and Planning Manager

United Utilities



Resilience, at what cost?

Managing water infrastructure assets as we aim for zero supply interruptions.

United Utilities

Water for the North West

United Utilities strategy for reducing leakage

Network leakage

A transformation from "find and fix" to Dynamic Network Management, predicting and preventing leaks to drive continual improvement in our leakage performance

Prevent

Optimise our networks to keep them "calm"

Use technology to monitor the condition of our assets remotely, and adapt our maintenance accordingly

Invest directly in water network asset health

Aware

Targeted enhanced monitoring and data analytics to identify and predict leaks in the water network

Implement a smart metering strategy to help us distinguish leakage from consumption (also a core part of our consumption strategy)

Locate

Collaborating with our supply chain to automatically and specifically pinpoint leak locations

Mend

Repair prioritisation based on customer impact and size of leak

Reduce disruption with "no dig" and "in pipe" repair techniques

Preferred plans

Short term

- In pipe-repairs and lining technologies
- Full smart metering
- Optimisation of the water network
- Mains renewal

Long term

- Additional network sensors
- Continued mains renewal

OUR FUTURE PLAN

Leakage Strategy Summary

26.4% reduction from 2017-18
23.8% reduction from 2019-20 (three-year average)

Digitally enable our network to provide first class service at the lowest whole life cost

A transformation from "find and fix" to Dynamic Network Management, predicting and preventing leaks to drive continual improvement in our leakage performance

Prevent

Optimise our networks to keep them "calm"

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Maintaining leakage (AMP8 base)

- Leakage detection capability, leak repairs, network meters and sensors
- Water network asset health and maintenance
- Water Dynamic Network Management platform, additional sensors and analytics

~50 Ml/d leakage reduction (AMP8 base plus AMP8 enhancements)

- ~35 Ml/d reduction from renewal/ replacement of 695km of water mains
- ~12 Ml/d reduction from ~1m household and non-household smart meters
- ~3 Ml/d reduction from network and pressure optimisation

Abstraction → Distribution input

Live "mass balance" for water (and wastewater)

Supported by our metering ambitions, we're developing a live mass balance from abstraction to customer

Water delivered → Water consumed

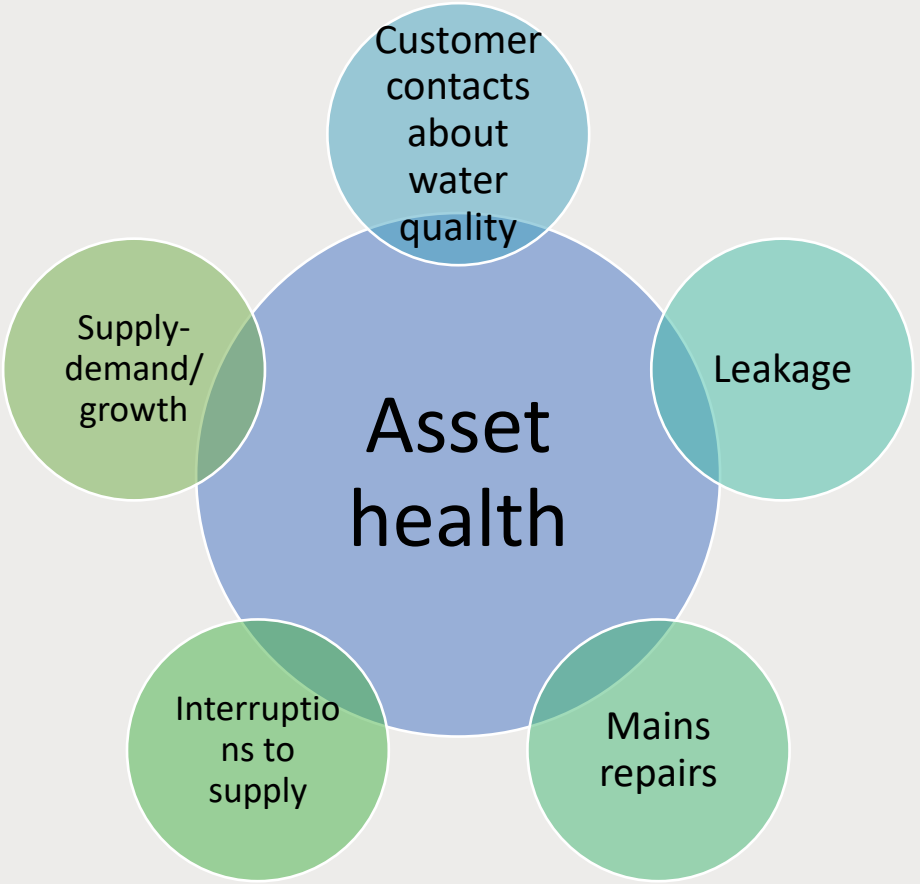
Future priorities

What do you see you as the #1 priority to drive leakage improvements in AMP8?

Slido poll #1

Optimising asset health investment

Asset Health ‘roundabout’



Key Points

Performance improvement

Asset stewardship

Optimise investment

Resilience

What hurdles do you see to delivering a resilient water network?

Slido poll #2

Mains rehab and renewal

Planned vs Reactive

What we need to consider….

- **Customers**
- **Regulation**
- **Solutions**

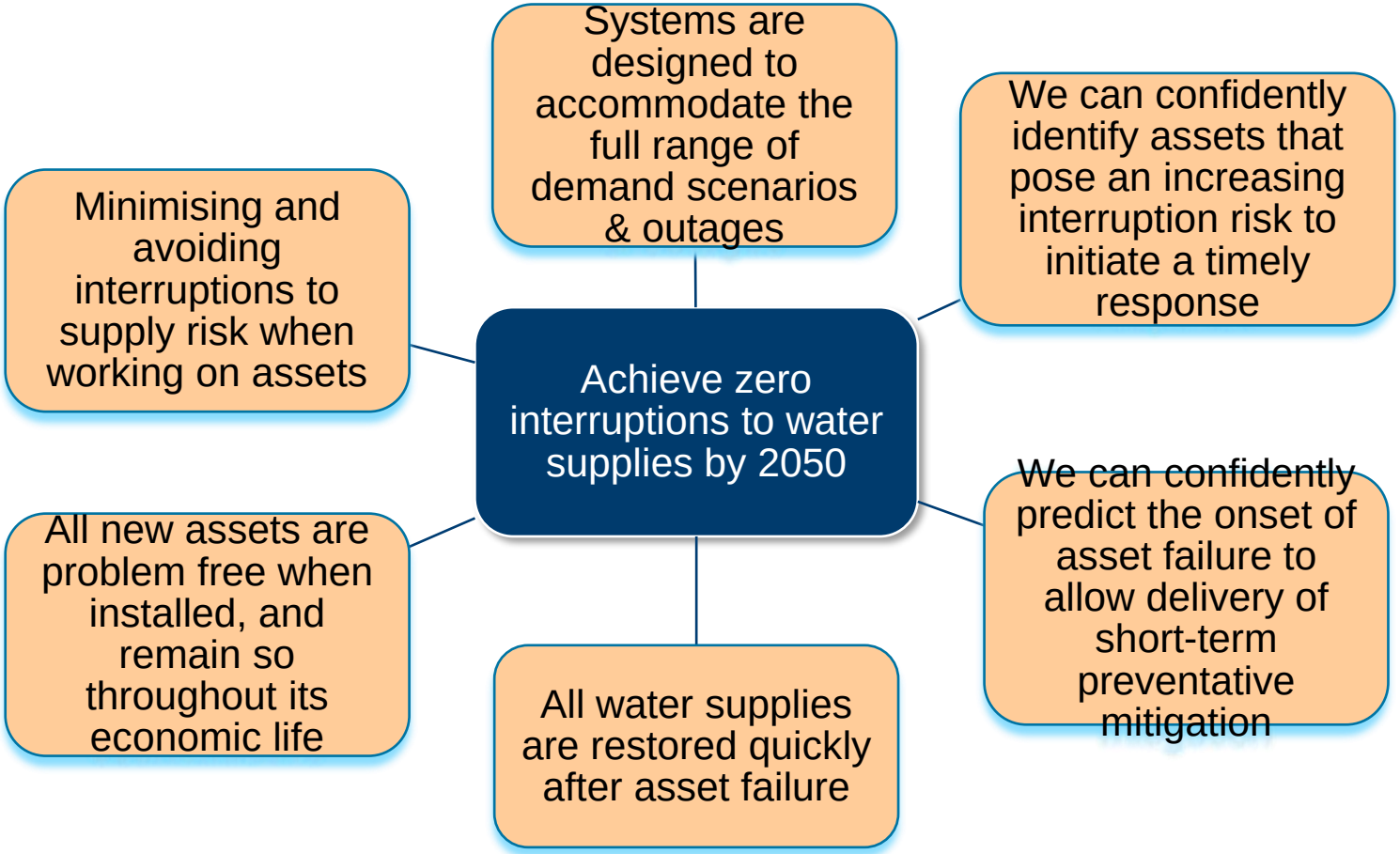
Source: theconstructionindex.co.uk/

Trenchless

Novel lining

Innovation…

This Big Question – desired outcomes



Project: optimising and balancing short-term operational interventions with long-term capital maintenance to improve water supply interruptions

Background:

- Uncertainty in the balance to be struck between:
  - short-term operational interventions and investment (e.g. tankering)
  - longer-term capital maintenance (e.g. trunk main maintenance and renewal)
- Diversity across the sector in investment priorities to achieve event resilience and recovery.

Aiming to Achieve:

- Identify and develop effective planning methods to optimise short and long-term interventions

Note: Project currently out for tender following EOIs

Thanks for your input.

Questions

Visit the UKWIR website to find out more about the Big Questions….

https://ukwir.org/big-questions-facing-uk-water-industry

Ofwat Innovation Fund Leakage projects

Universal access point for water – UAP4W

Jeremy Heath

Innovation Manager

SES Water

Universal Access Point for Water

UAP4W

Jeremy Heath
Innovation Manager
SES water

UAP4W – Leak inspection and location

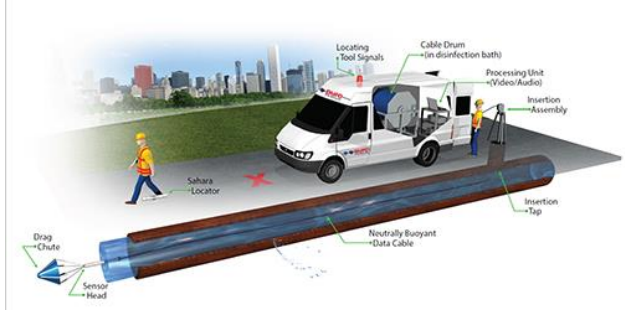
Examples of current and under-development devices that require access to a pressurised water main

- Tethered and untethered leak location arrays
- Pipe inspection camera solutions – for condition assessment and leak localisation
- Water quality sampling solutions
- In-pipe fibre optic solutions
- Internal mains repair sealants
- Autonomous robotic inspection and repair solutions

UAP4W – Current insertion techniques

Hydrant

Under pressure T



Custom solutions

UAP4W – Suggest features

Universal Access Point for Water suggested features:

- Be installed when the main is laid, or subsequently cut into the pipe.
- Be available for a range of mains materials and diameters
- Will have a single standard entry port, which would remain the same size regardless of the pipe diameter.
- Will allow devices (both tethered and free-swimming) to be inserted safely and cleanly into the pressurised water mains and subsequently removed.
- Will additionally incorporate safety features to ensure that unauthorised access to the pressurised water main is not possible.
- Will provide connection points for flow, pressure and water quality connection points

UAP4W – Project scope

Universal Access Point for Water IP and scope:

The scope of the project is purely to develop a design for a UAP4W. Following successful completion of this phase, the project outputs could then be used to develop prototypes either by manufacturers or by applying for additional innovation funding.

The project outputs would be open innovation, with no intellectual property associated or claimed by the design. This would allow the project outputs to be adopted easily by manufacturers or other partners.

UAP4W - Advantages

Universal Access Point for Water advantages:

The standardised dimensions of the UAP4W would allow the development of devices which currently could not be inserted via a hydrant, with better sensor, data storage and battery capability.

In addition, the use of a UAP4W would provide better opportunistic data. For example, the installation of a UAP4W following a burst and mains cut-out, would allow the main to be swiftly returned to service, and then the main subsequently internally inspected via camera prior to backfill.

UAP4W – Project Partners

ses WATER

ses WATER

NORTHUMBRIAN WATER living water

Southern Water

United Utilities

Thames Water

wrc
independent | trusted | innovative

University of Sheffield

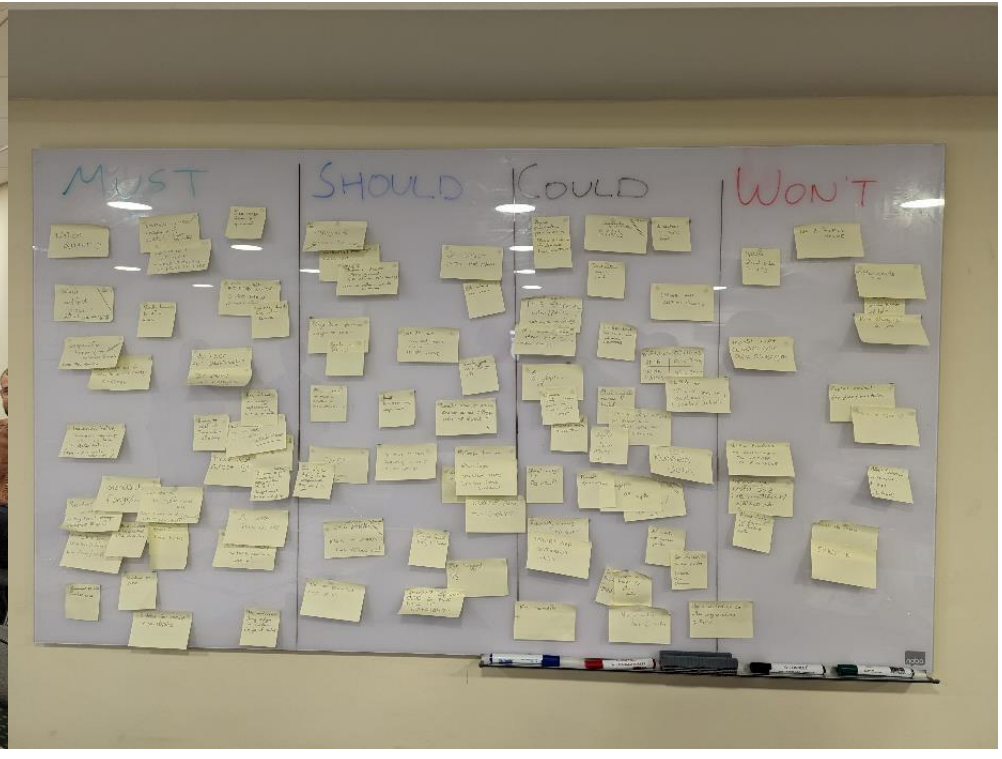
Fluid Consulting Ltd

UAP4W – Project plan

The design of the UAP4W would comprise four work packages

- **Work Package 1 – Vision, Requirements and Specification**
- **Work Package 2 – Economic Assessment**
- **Work Package 3 – Development of Design Ideas**
- **Work Package 4 – Preferred design and Next Steps**

UAP4W – Project plan



UAP4W – Project plan

Why do we need a UAP
Water quality / safety / leakage
Existing fittings not fit for purpose / poor condition
Standardised and greater access to the network

Current Limitations
Hydrant angles of access and through bore are limiting
Under pressure T's have snags
80mm hydrant entry is small, limiting sensor size
Hydrants identified and visible to all
Too many bends from hydrant
Access points used by others

What will it enable
Entry for equipment preventing damage and sediment
Use on any main size and under various pressures of flow without supply interruption
Proactive pre-emptive monitoring
Reduce background leakage, difficult to detect leaks. Finding leaks on plastic pipes
Secure access
Asset location
Pipe condition assessment
Water quality monitoring – ability to leave in the main

UAP4W – Project plan

Must
Water Quality; water safe
Minimum chamber size; standard entry size
Work under High flow, low flow, no flow
Flushing point
Air valve/ air release sideways
Allow device to be inserted in either direction (upstream/downstream)

Should
Located direct onto the main
Lockable, secure chamber access
Operable from the surface / 1m metre depth maximum - removing confided space requirements
Smaller diameter mains smaller access drillings UPT or physical T
Easily pass radio through lids
Portable oxo, shut-out debris clear, double valve

Could
Waterlock to allow easy insertion of devices
Isolation of access point
Larger diameter than current hydrants
Allows disinfection of devices being installed
Best practice RAMS to aim use
Suitable for varied pipe material

Wont
Won't be designed for use as a fire hydrant, air valve or for mains flushing;
Won't be "only in"
Won't include butterfly valves
Won't be design so it cannot be buried
Won't compromise pipe strength

UAP4W – Project plan

The design of the UAP4W would comprise four work packages

- Work Package 1 – Vision, Requirements and Specification
- **Work Package 2 – Economic Assessment (ongoing)**
- **Work Package 3 – Development of Design Ideas (Workshop June 24**
- **Work Package 4 – Preferred design and Next Steps (Workshop Sept. 24)**

Questions?

Active pulse leak detection
Next generation leak detection: Active Sonar

Michael Purvis
Managing Director
Seal Water Technology

William Smith
Technical Director
Seal Water Technology

Presenters: Michael Purvis

William Smith

Next Generation Leak Detection: Active Sonar

Problem & Paradigm

Accurate leak detection is key part of the solution

The need for highly accurate, cost and labour efficient leak detection has never been greater.

Current paradigm

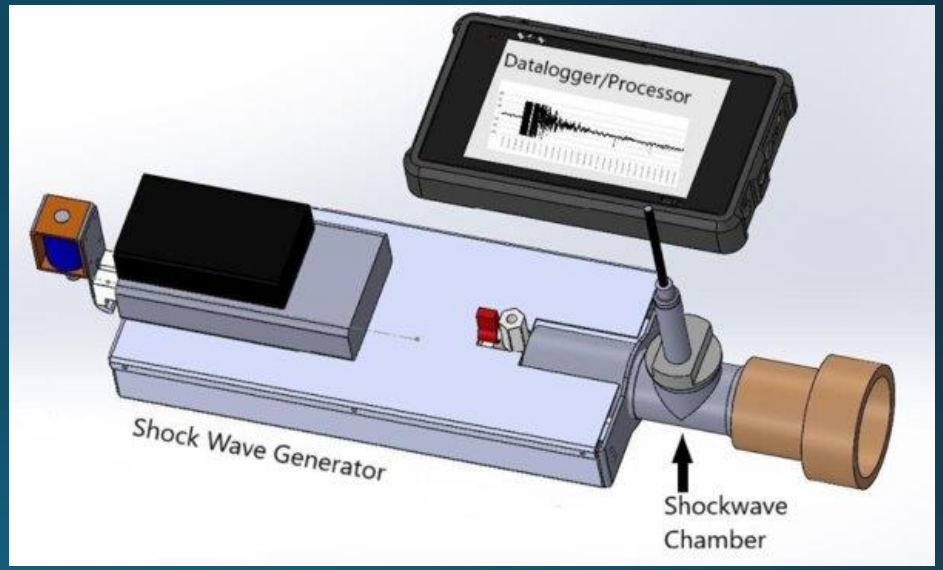
Current best technology of “Correlating Acoustic Sensor” is labour intensive, expensive and infrastructure heavy.

Breakthrough Technology

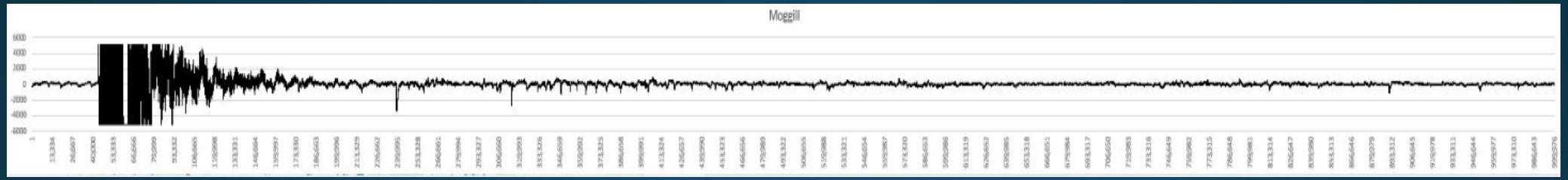
How it works

Active Sonar generates a very small but intense pulse.

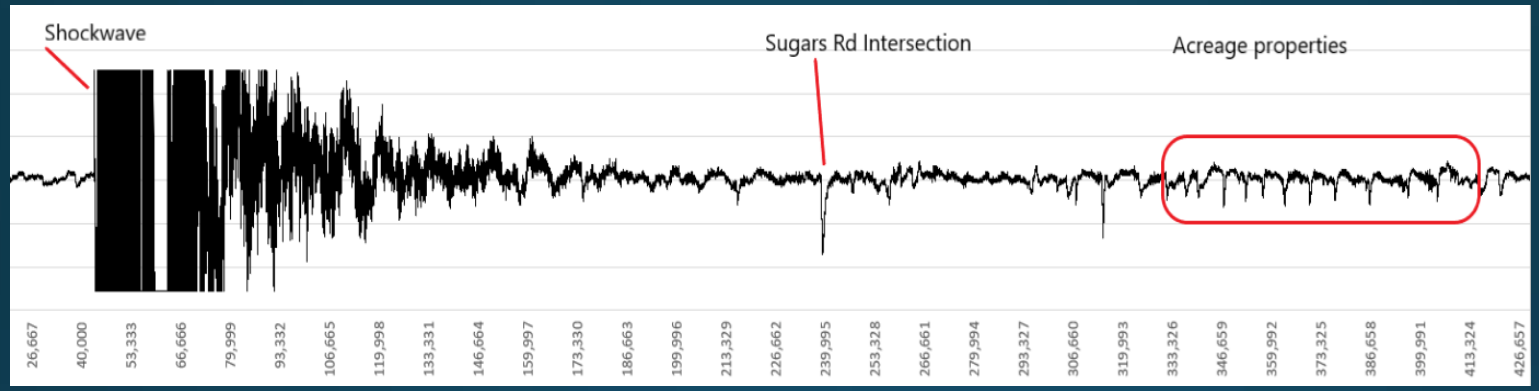
This is injected into the water causing 7.5 km of pipe to "Talk to us".

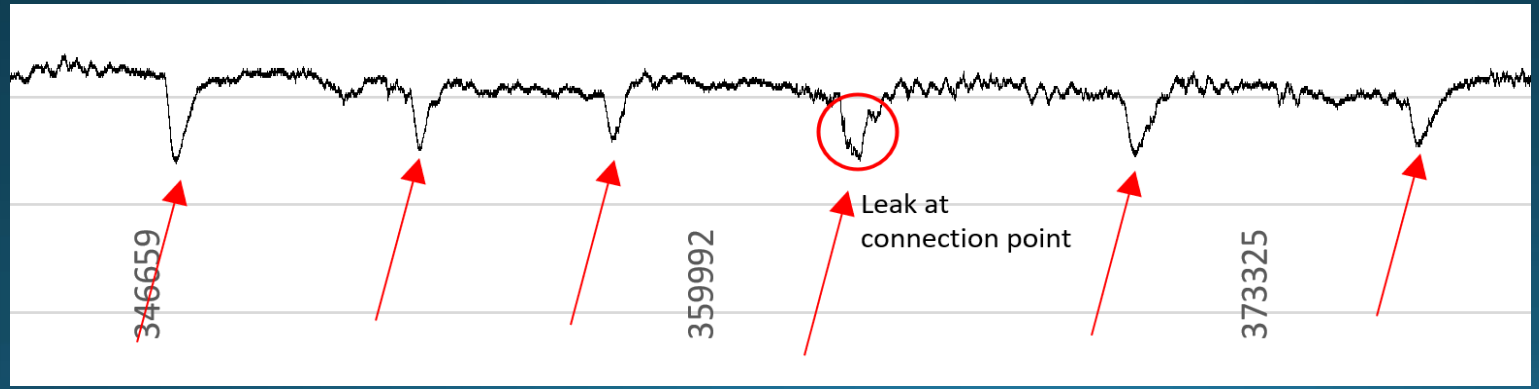


7.5 km Pipe Data Set



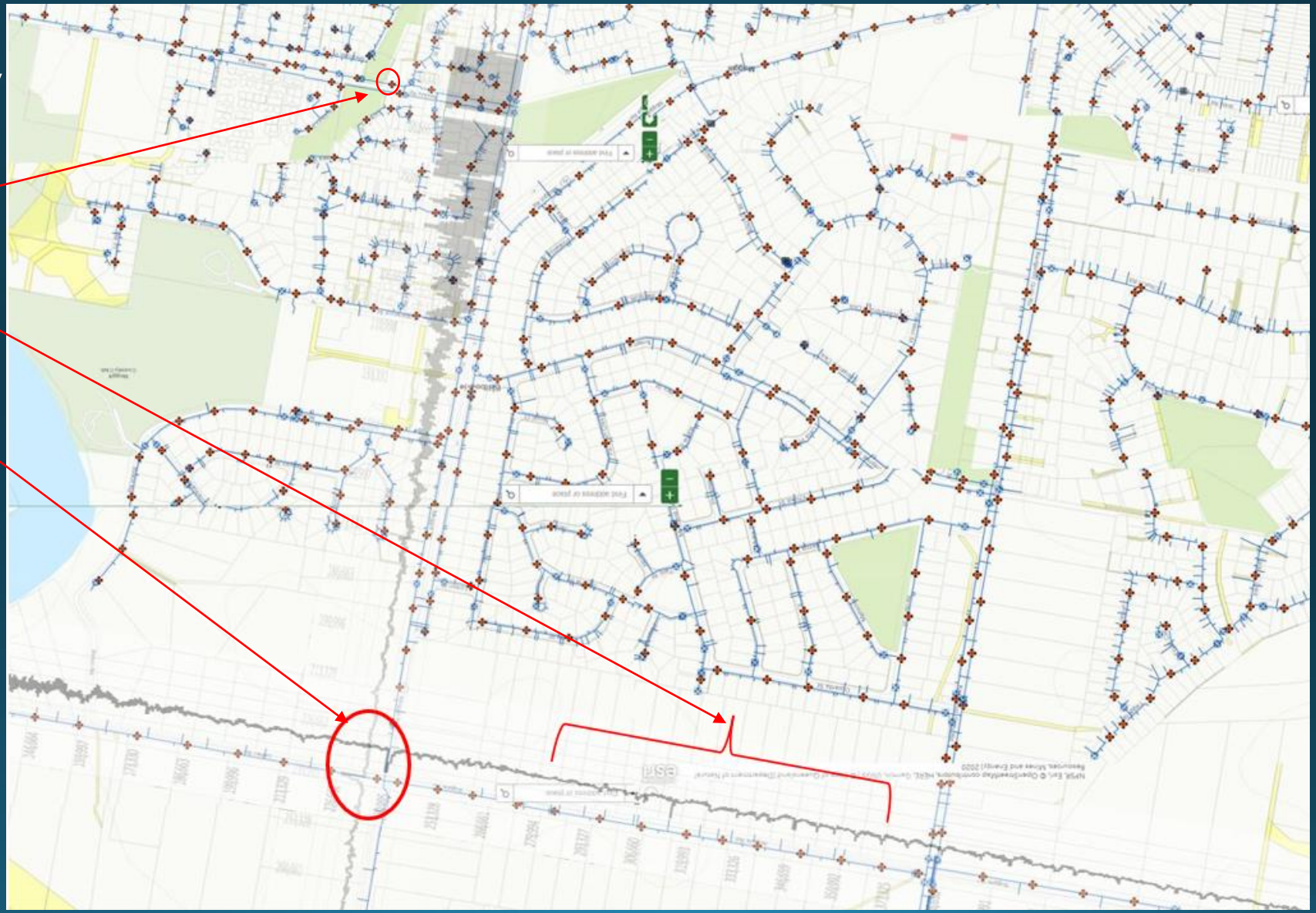
Leak Identified – 3.6 km away





Map Overlay

- Test station circled
- Acreage properties identified
- Sugars Road intersection identified



Value

Long Range

Non-destructive and Non-intrusive

Low Infrastructure Cost for DMAs

High Risk Critical Infrastructure

Traction

The inventive step and physics is established

Strong patent registered with 23 claims

POC trials with Portsmouth Water & WLLS

Brands Hatch

3 other UK Utilities very interested

Strong Team

Key developers of the technology	Dr Duncan Hywell Evans William Smith Ying Li
Other key members of staff	James Bess Dr Leonard Casson Michael Purvis Dorothee Nachez
Ofwat mentors	Danielle Hankin - Yorkshire Water Jez Heath - SES Water

Our Vision

Questions?

Managing background leakage

Stuart Trow

Consultant

HWM Invenio

Managing Background Leakage

An Update

Stuart Trow

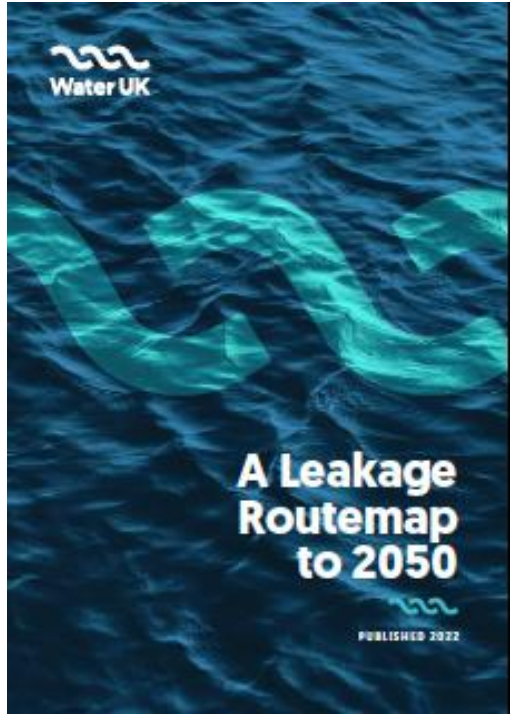
HWM / Invenio Systems

Portsmouth Water · Dŵr Cymru Welsh Water · love every drop anglianwater · Affinity Water · invenio · HWM

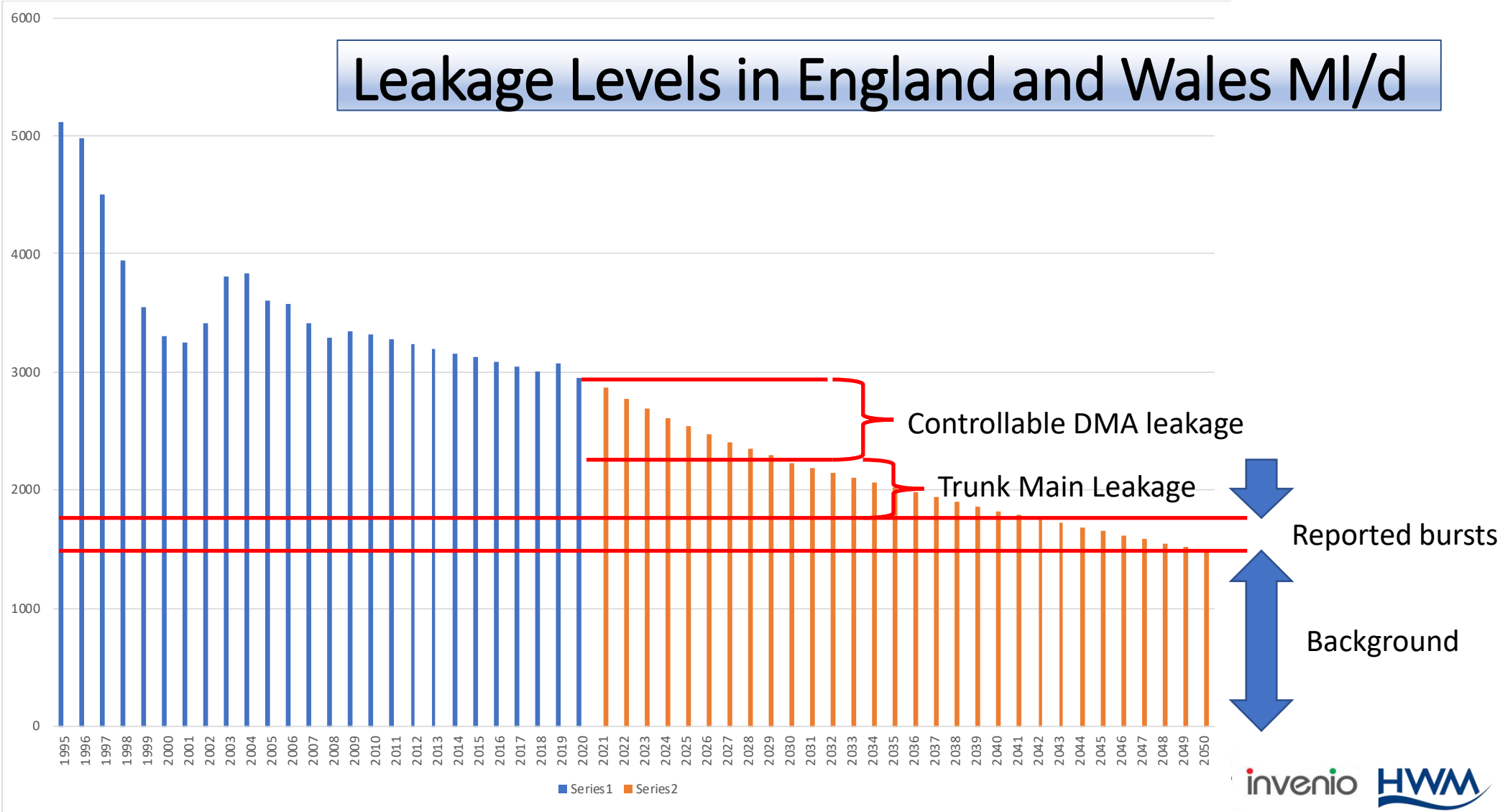
Water UK Routemap Definition

Background leakage:

This is the level where leakage cannot be reduced further, using current detection technology. This can be altered by replacing pipes in the network, but also by reducing pressure in the network. It can also change due to new technological innovations that make detection more effective.



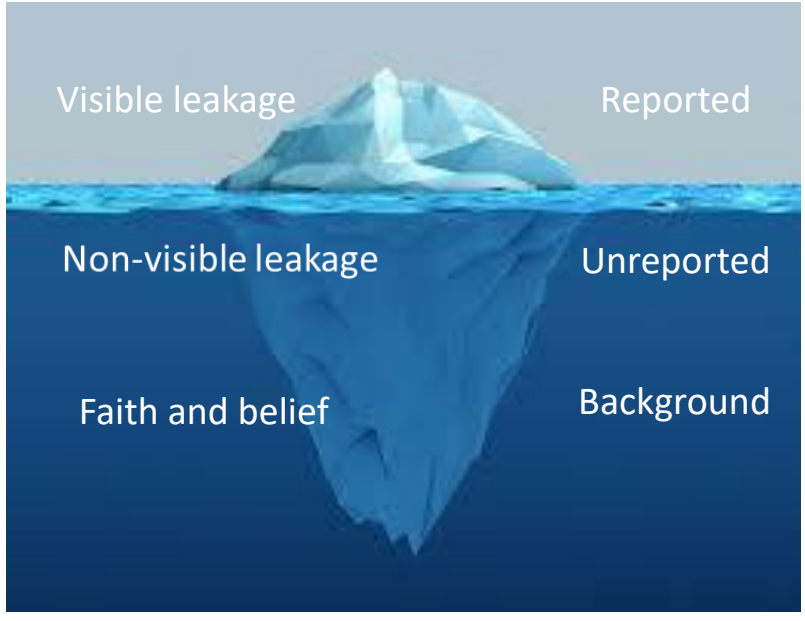
Leakage Levels in England and Wales Ml/d



invenio HWM

MAL and MAbL

- **MAL** = Minimum Achieved Leakage
  - This is the historic minimum achieved levels of leakage in DMAs from night flow measurements
- **MAbL** = Minimum Achievable Leakage
  - This is the theoretical minimum level of leakage in DMAs based on the Background Leakage for infrastructure in “Good” condition



MAL - Effectively all the leaks that a “normal” leakage sweep don’t pick up

Managing Leakage 2011, Report 4

Background Loss Component	Units	Condition		
		Good	Average	Poor
Infrastructure Condition Factor (ICF)		0.5	1.0	1.5
C1: Distribution mains	l/km/hr	20	40	60
C2: Communication pipes	l/conn/hr	1.5	3.0	4.5
C3: Supply pipes – UGSP:				
either (av length 15m)	l/prop/hr	0.25	0.5	0.75
or	l/km/hr	16.7	33.3	66.7
C4: Supply pipes – plumbing	l/prop/hr	0.25	0.5	0.75

Table 3 Background night flow losses at 50m pressure

- The term Background Leakage was introduced in Report E of Managing Leakage 1994
- Defined as the level of leakage from the collective sum of minor leaks from valves, joints, hydrants, stop-taps, meters and boundary boxes on mains and services pipes; and from dripping taps and overflows from lavatory cisterns and roof tanks.
- It was believed these would be very small, rarely >100l/hr and not individually identifiable from DMA night flow measurements.
- It was considered that any leak >100l/hr should be found, but the report acknowledged there could be some undetected leaks in the range 100–500 l/hr in rare circumstances.
- It was expected that these levels might reduce with time as new technologies for leak detection were introduced

Water Breakthrough Challenge: Transform Stream

- The project aims to redefine the detectable limit of leakage by showing whether Background Leakage / MAL can be reduced by locating long running hidden leaks that have evaded detection
- Led by Welsh with direct support from Anglian, Severn Trent, Portsmouth and Affinity
- £3.5m project over 30 months
- Contractors: HWM / Invenio Systems and University of Sheffield

Select DMAs for Survey (500 to 900 properties)

Install multiple sensors

Create a digital twin model of the DMA

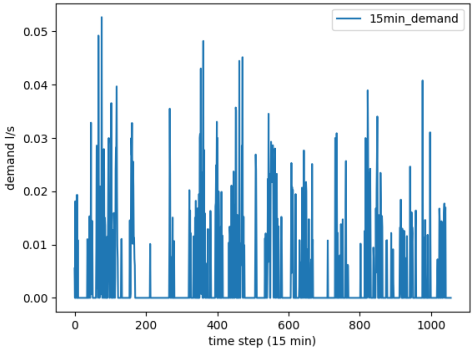
Localise leaks

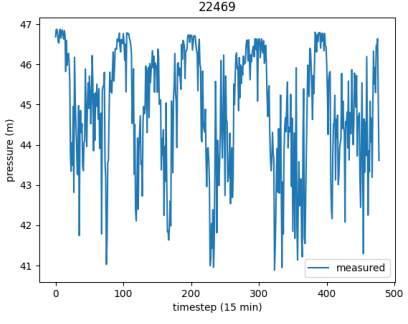
Locate leaks

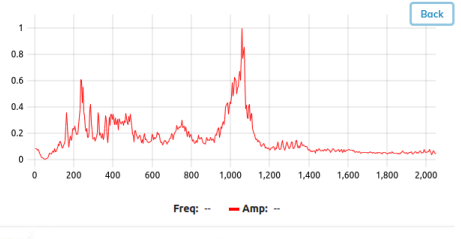
What are we doing differently ?

Phase 1: 10 DMAs to January 2024

- All connections network model of each DMA
- Actual consumption profile @ 1 min resolution for the majority of connections based on Stop.Watch
- Smart meter data used where available
- Modelled consumption profile for the remainder based on those logged
- Fitting pressure loggers to every available hydrant: 20 to 25 per DMA; 15-minute values
- Transient 100Hz Pressure Logging 24/7 on 3-4 points per DMA using HWM LX Loggers that have been newly developed specifically for this Project
- Installing acoustic loggers at high density 30 accelerometer sensors, sending nightflow acoustic readings
- Combining data sets to identify areas of interest







Current Status

SEVERN TRENT

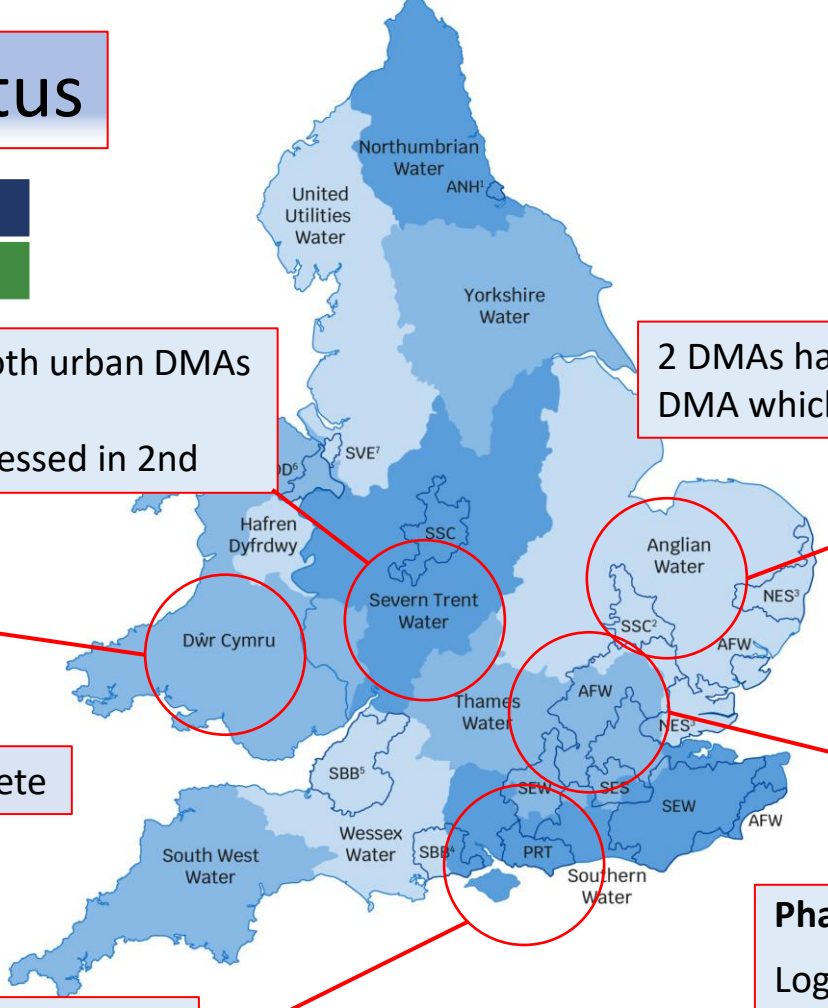
Field work complete in both urban DMAs
Area of interest in the 1st
Data currently being processed in 2nd

Dŵr Cymru Welsh Water

Surveys and analysis complete

Portsmouth Water

Surveys complete. Further data being collected for modelling



love every drop anglianwater

2 DMAs have been selected. Fieldwork starting in the 1st DMA which has a high percentage of Smart Meters

Affinity Water
Your local supply, on tap

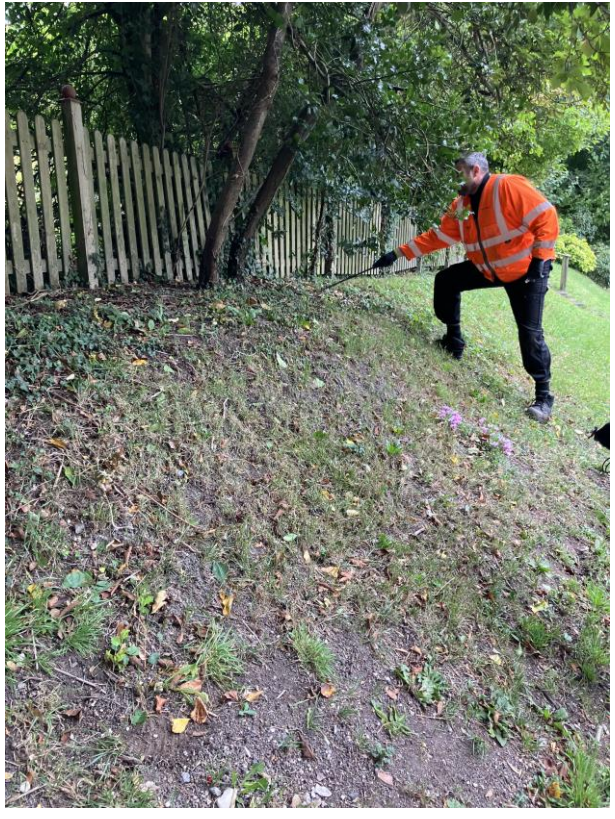
DMA selection being finalised

Phase 2: 15 DMAs January 2024 to January 2025

Logging and analysis to be scaled back and streamlined to develop a cost-effective process

University of Sheffield · SEVERN TRENT · Portsmouth Water · Dŵr Cymru Welsh Water · love every drop anglianwater · Affinity Water · invenio · HWM

Difficulties experienced



proved difficult, with long lengths of mains and hidden

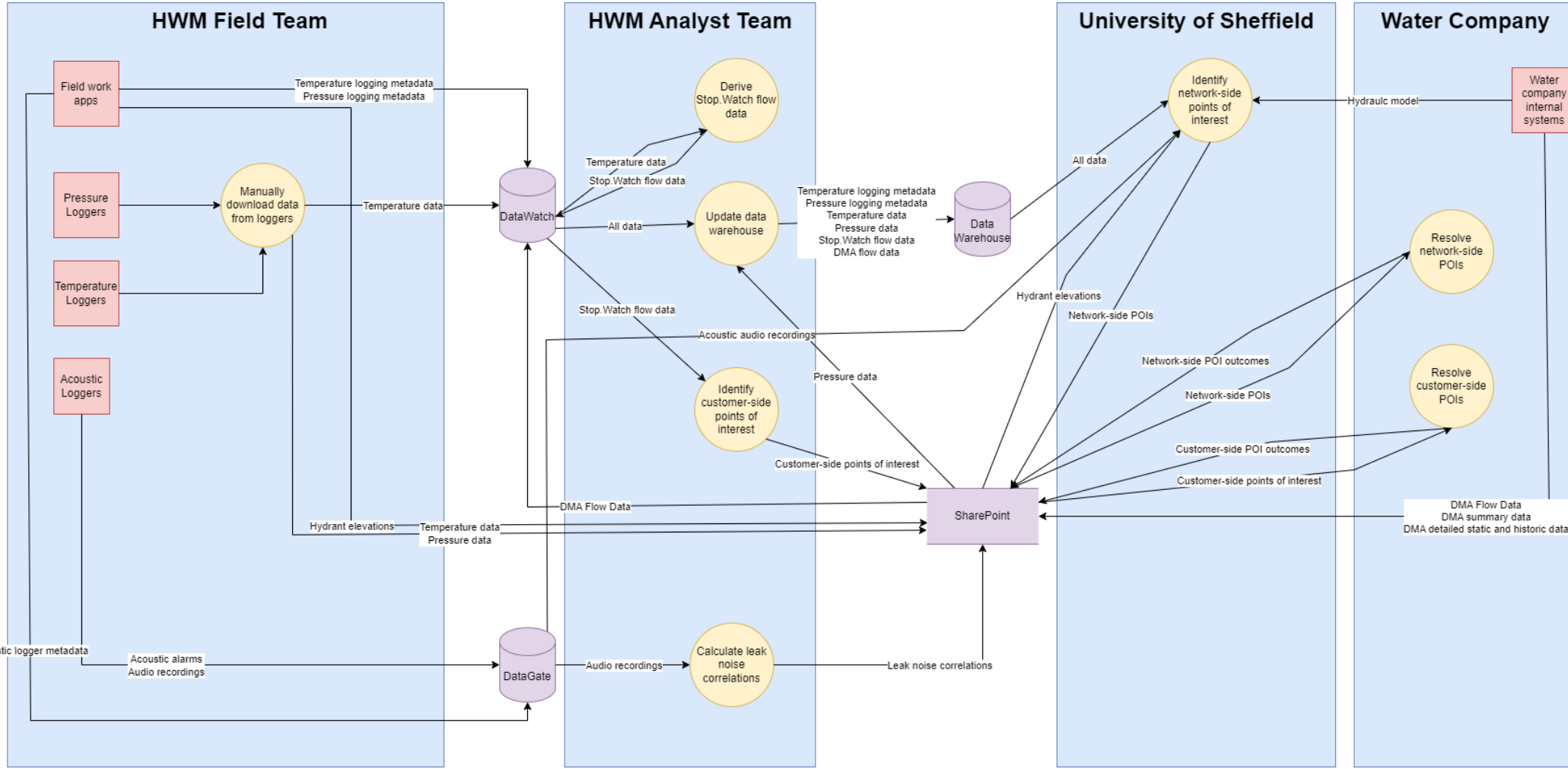
Country Lanes with no pavements, chambers in the roadway, and national speed limits

High Speed main roads in Urban areas are not accessible

Hidden, buried and missing stop taps. Wall mounted meter boxes

Blocks of flats, commercial properties

Data flow diagram



Water Breakthrough Challenge

Dŵr Cymru Welsh Water

Water Breakthrough Challenge
Transform Stream

Managing Background Leakage

Stage A Report

Draft

Date: 06/01/2023

Issue: Draft v.1.0

SEVERN TRENT

love every drop anglianwater

Portsmouth Water

Affinity Water

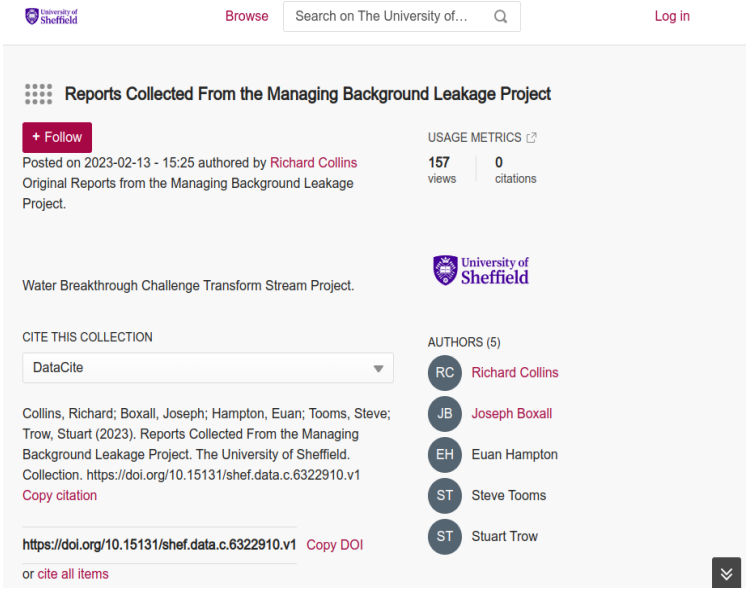
invenio

University of Sheffield

31 Page Report sets out the work carried out in Stage 1 at the end of 2022 before field work started

In the public domain via a Figshare link:

https://figshare.shef.ac.uk/collections/Reports_Collected_From_the_Managing_Background_Leakage_Project/6322910



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Company Reference	Background leakage in DMAs Ml/d	Adjusted Unreported DMA Leakage (Ml/d)	Adjusted reported DMA leakage (Ml/d)	Total DMA leakage (Ml/d)	Trunk main and service reservoir leakage (Ml/d)	Total MLE KPI leakage (Ml/d)
Anglian	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
DCWW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Portsmouth	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Severn Trent	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Affinity*	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total	456.1	289.8	47.9	793.8	141.6	935.4

Table 1 shows the component values of the reported KPI level of leakage for each company in Ml/d. The total of 935.4 Ml/d is about 30% of the total for England and Wales; so it is a good size sample.

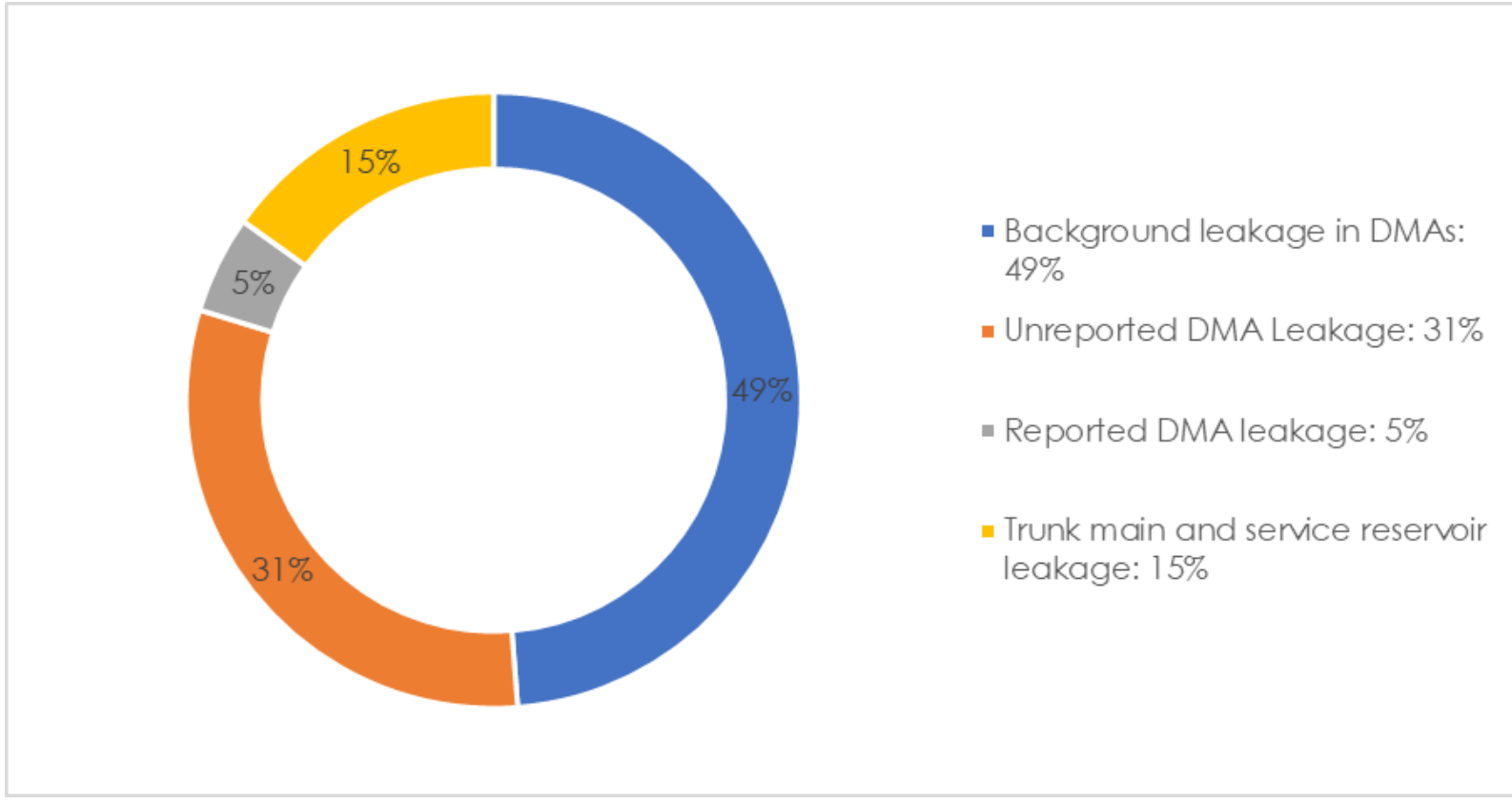


Figure 1: Proportions of leakage components in the companies as a whole

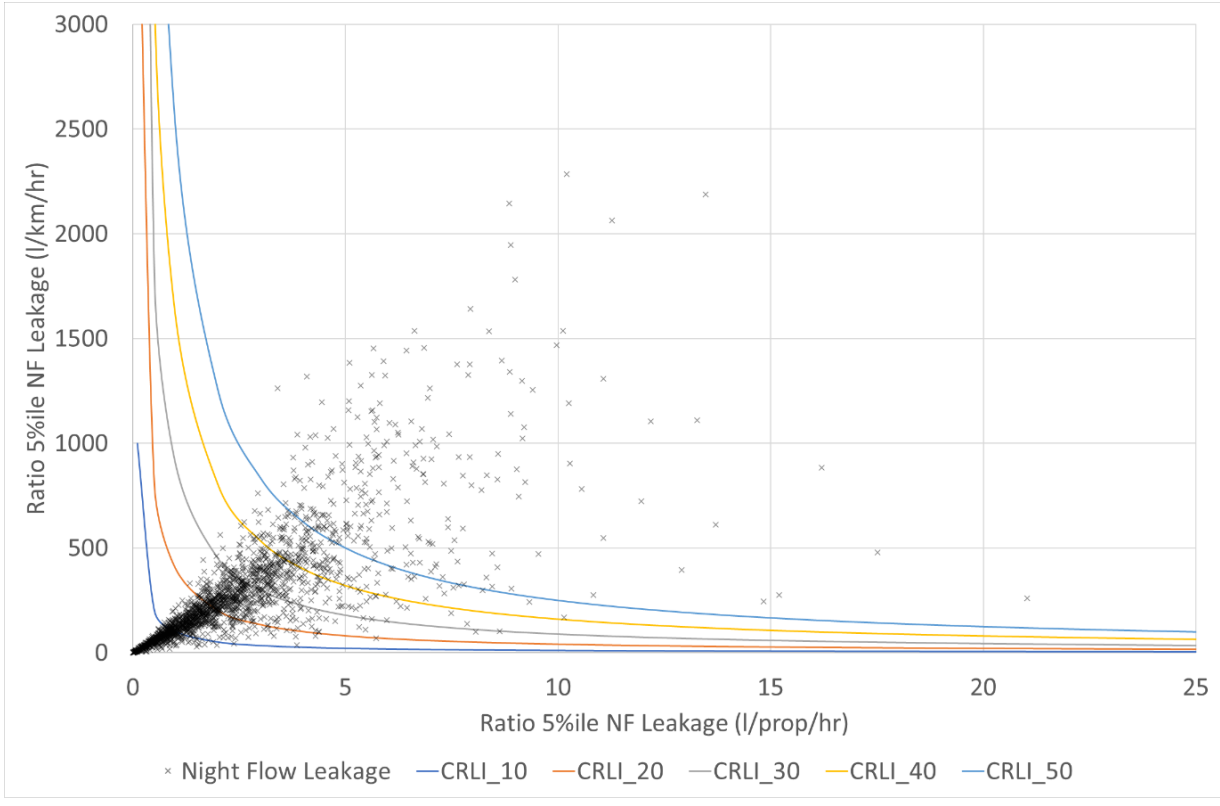


Figure 2: Range of DMA-level lowest achieved night flow leakage

- Figure 2 shows the range of 5%ile MAL values across the DMAs in the participating companies on two axis graph scaled by the length of mains and the number of properties.
- The CRLI contours are there to show the lines of equal 'leakiness' for urban and rural DMAs with different lengths of mains per property supplied.
- It can be seen that there is wide range of CRLI values with a grouping at the low end tending towards zero.
- At the other extreme there are DMAs with very high CRLI values in both the urban sector (top left) and rural sector (bottom right).
- This challenges the current definition that background leakage is due to a large number of small leaks. Were that the case a far narrower range of MAL values would be expected.

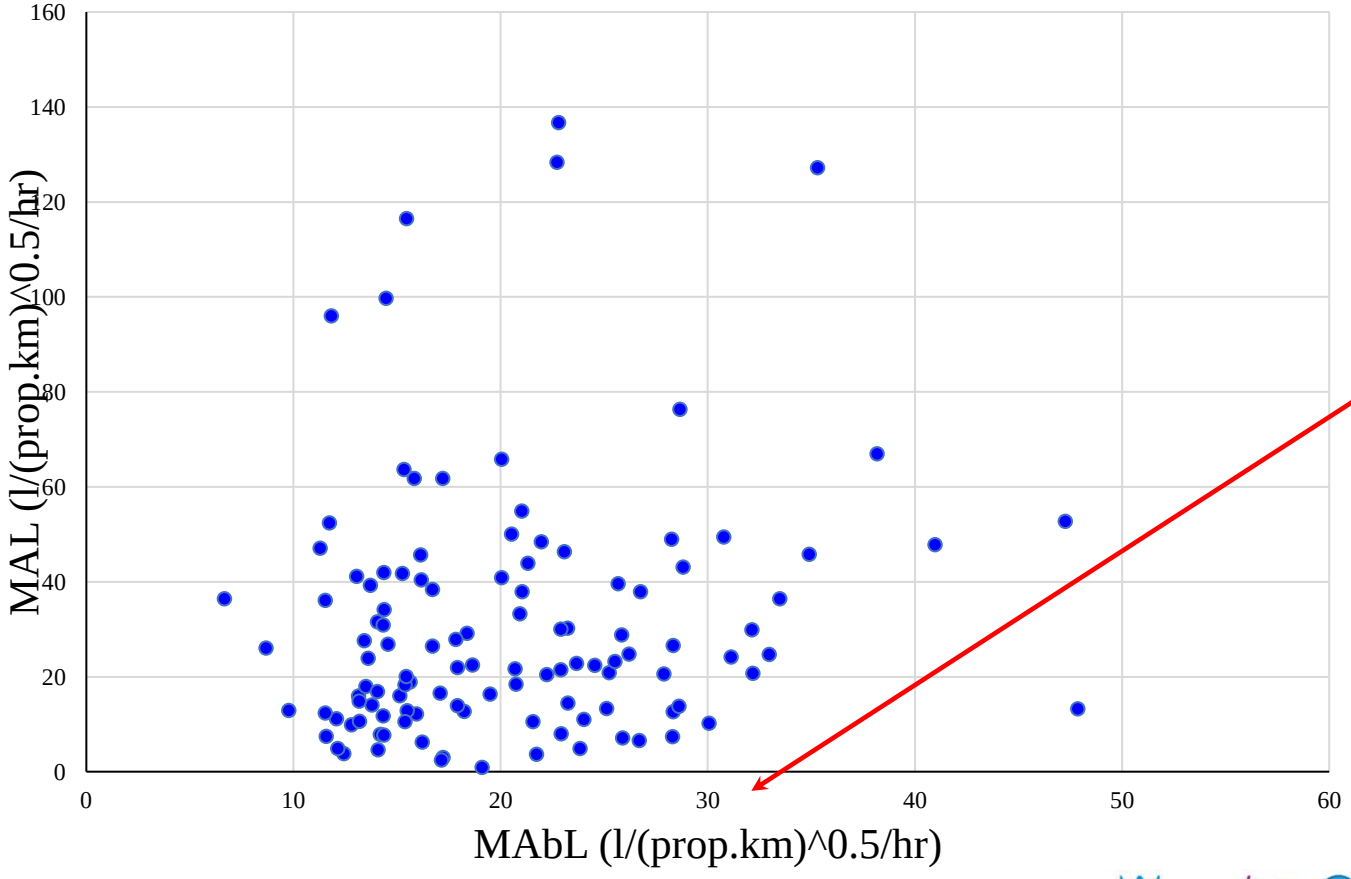
Results of Consumption Surveys

Anonymised Network Name	Property Count	Water company estimate of MAL (l/hr)	HWM estimate of MAL at time of survey l/prop/hr	HWM estimate of MAL l/hr	HWM estimate of night use (not including plumbing losses) (l/prop/hr	HWM estimate of customer side leakage (including plumbing losses) (l/prop/hr)	HWM estimate of network leakage (l/prop/hr)	HWM estimate of night use (not including plumbing losses) (l/hr)	HWM estimate of customer side leakage (including plumbing losses) (l/hr)	HWM estimate of network leakage (l/hr)	HWM estimate of network leakage (l/prop/hr)2	Running Average (l/prop/hr)
netA2	666	4184.61	7.75	5162	3.43	4.32	0.00	2284	2877	0	0.00	0.00
netA1	531	4244.86	12.95	6876	3.70	5.56	3.69	1965	2952	1959	3.69	1.64
netB2	501	2191.07	9.50	4760	4.87	0.75	3.88	2440	376	1944	3.88	2.30
netC2	790	3159.46	14.06	11107	3.09	10.05	0.92	2441	7940	727	0.92	1.86
netC1	749	2909.17	13.80	10336	2.53	6.46	4.81	1895	4839	3603	4.81	2.54
Total / Ave	3237	16689.17	11.81	38241	3.41	5.86	2.54	11025	18983	8233	2.54	
Percentage		**43.6%**		**100**				**28.83%**	**49.64%**	**21.53%**		
								PL @ 1.4 l/prop/hr	4532	**11.85%**		
								>> USPL	14451	**37.79%**		

Customer side leaks detected – internal and external

	Number	Total Flow (l/hr) (%)	
Small	135	2202	11.6%
Medium	48	2594	13.7%
Large	40	14186	74.7%
Total	223	18982	

MAL vs MAbL CRLI Values for one water company

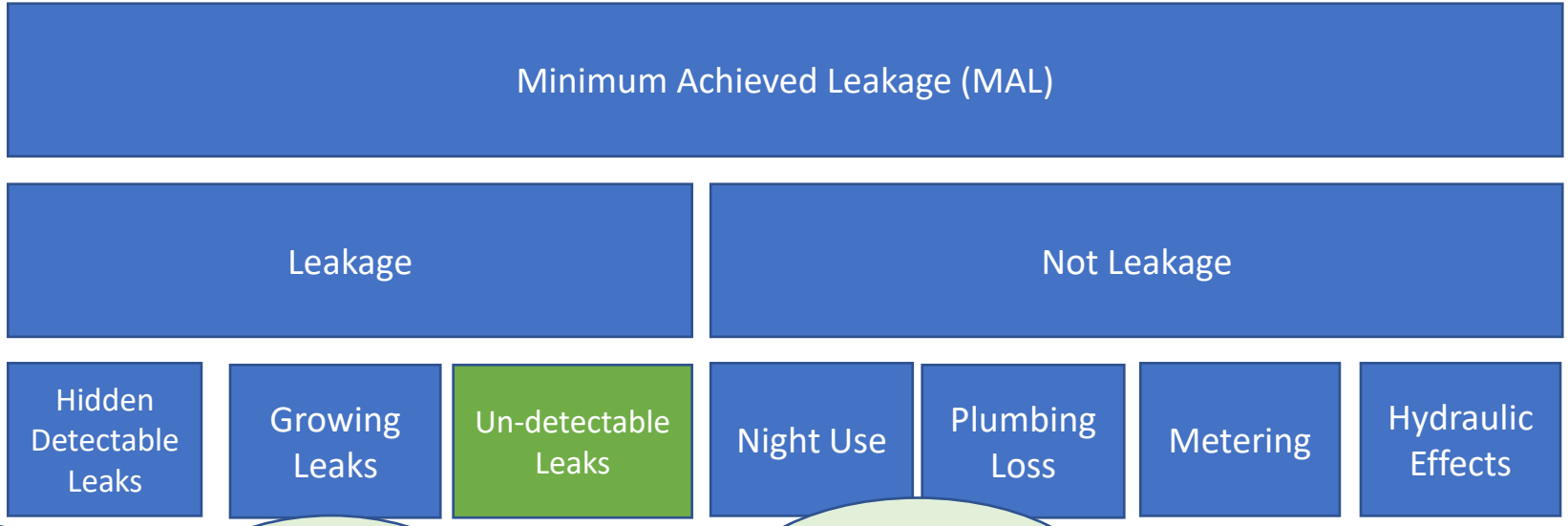


Pressure corrected MAbL

Is background leakage as defined in Managing Leakage reports?

- It is highly unlikely that BL is due entirely to small leaks below the detectable threshold as defined in Managing Leakage and the WaterUK Routemap
- It is more likely that MAL is due to a combination of detectable leaks, gross errors in flow measurements, and errors in the leakage estimation process

Components of MAL



Large hidden leaks that have not been detected by normal methods

The concept of leaks in their early stage of development is in a 2005 UKWIR report.

Water delivered to a small number of customers being much higher than estimated.

Inaccuracies in the measurement of low night flows to measured customers

Questions arising - Food for thought

- Should small customer side underground supply pipe leaks be included in the water company leakage KPI ?
- How can we assess the true level of DMA night consumption (night use and plumbing loss) without Smart Meters and/or full Stop.Watch surveys ? Without that we could be working on a misleading estimate of DMA leakage.
- Is there a standard way of reporting MAL levels?
- Will mains replacement reduce background leakage, or maybe we should just replace service pipes ?
- What will be the impact of Smart Metering ?
- Are the Managing Leakage values useful for estimating MAbL at DMA level ?

Thank you

Stuart.Trow@HWM-Water.com

Questions?

Closing remarks

Bob Taylor

CEO

Portsmouth Water

Networking in the Leakage Lounge

7.30pm Conference Dinner back in this room
with a presentation from
Pete Felton, The National Robotarium
Followed by networking

Tomorrow's cloakroom on the GROUND FLOOR from 8.30am

Syrinix Logo Artwork.ai

Meet up with our exhibitors and other delegates

aqualogic water conservation

BERMAD

GUTERMANN

HWM

MUELLER

OVARRO CONNECTING TECHNOLOGIES

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