

# UK WATER PARTNERSHIP

## Water Resilience Showcase

28 June 2023

30 June 2023



Department for  
Business & Trade

# Programme

## Blue Room

- 1 07:25 - 07:40 Managing Resilient Systems
- 2 07:45 - 08:00 Nature Based Solutions
- 3 08:05 - 08:20 Nature Based Solutions
- 08:25 - 08:30 Coffee Break
- 4 08:35 - 08:50 Digital tools for Resilience
- 5 08:55 - 09:10 Digital tools for Resilience
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- 7 09:35 - 09:50 Disaster Management: Preparedness

1

# Managing Resilient Systems

Adapting Existing  
Infrastructure

Improving water supply resilience  
of Metro Manila

**ARUP**



Adrian Marsden  
South East Asia Water Leader



Mervick Salamat  
Process Engineer

[Adrian.Marsden@arup.com](mailto:Adrian.Marsden@arup.com)  
[Mervick-Ann.Salamat@arup.com](mailto:Mervick-Ann.Salamat@arup.com)

**ARUP**



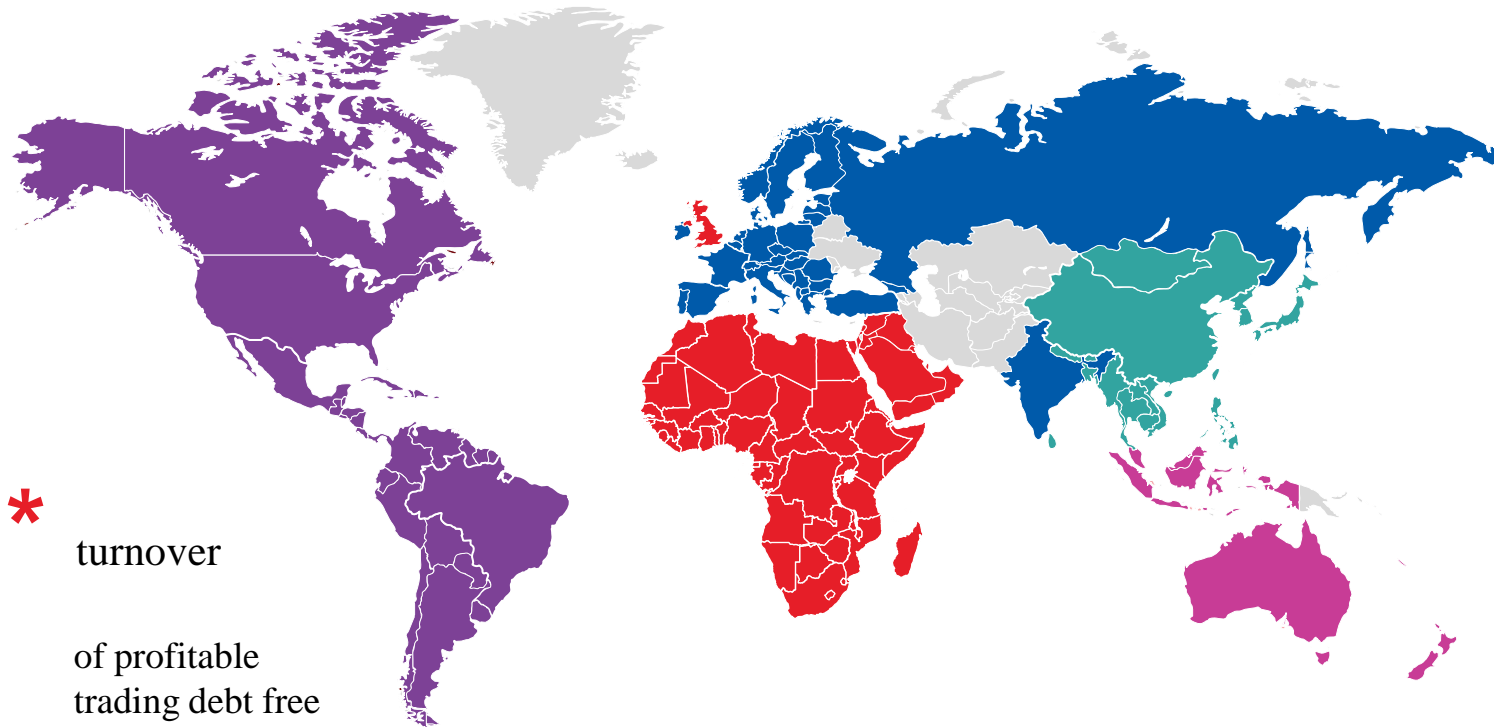
# La Mesa Water Treatment Plant 1

Improving the Water Supply Resilience of Metro Manila

**Adrian Marsden**  
**Mervick Salamat**

28 June 2023

# Arup's Global Presence



**90** offices

**40** countries

- UKIMEA
- Americas
- Europe
- East Asia
- Australasia

**\$3.2bn\*** turnover

**75 yrs** of profitable trading debt free

**16,000+** people

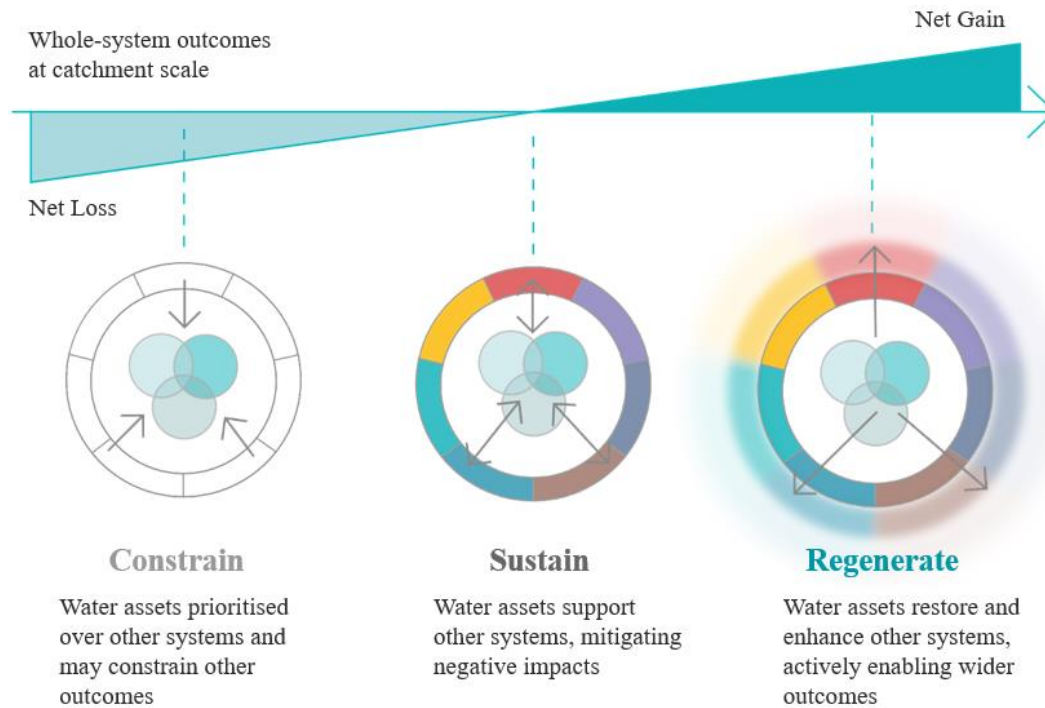
*as at Mar 2021 \*19/2020 financial year*



Department for Business & Trade

# Design with Water

Building water resilience in the face of climate change



Four cross-cutting principles that underpin Arup's approach to planning and designing with water

**HEADLINES**

# **Typhoon Ulysses high turbidity event**

Maynilad Water Services, Inc.

# Value Story

## La Mesa Water Treatment Plant 1 Upgrade

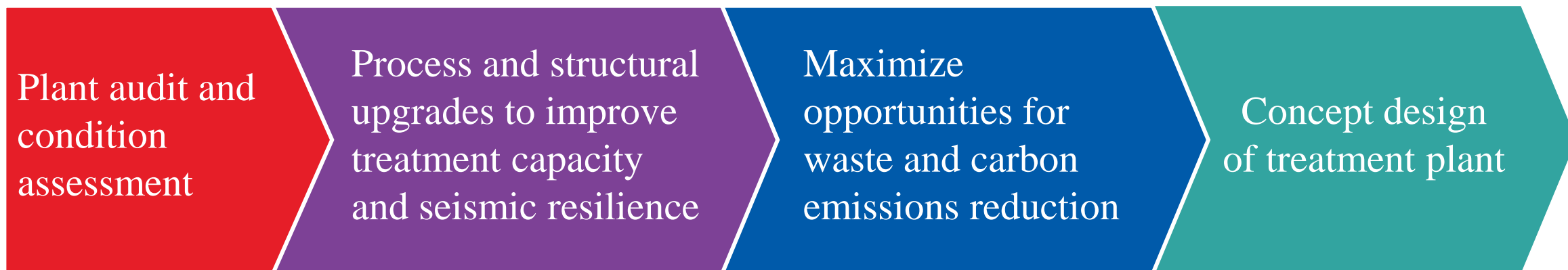
- Largest water treatment plant in Metro Manila
- Receives a wide range of inlet conditions
- No existing sludge handling system





# Our Approach

Added value in delivering the study



# Key Improvements

Reliable 24h water service



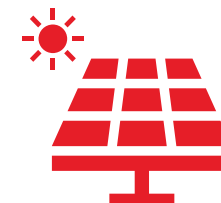
Recover and treat  
additional 9 MLD



Reduce power consumption  
by 50%



Reduce chemical  
consumption by 15%



Avoid 655 tons  
carbon emissions

# Key Challenge

What can we do through our work?



**FIDIC Contract Users Awards 2022**

**International Federation of Consulting Engineers**

Project of the Year





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Improving the Water Supply Resilience of Metro Manila

**Adrian Marsden**  
**Mervick Salamat**

28 June 2023

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# 2

## Nature Based Solutions

### Nature Based Solutions

Restoration of saltmarsh using a  
circular economy based model  
**Land & Water**



Tom Godfrey  
Managing Director

[tom.godfrey@land-water.co.uk](mailto:tom.godfrey@land-water.co.uk)





A division of  **LAND & WATER**

# Wholescape Innovation

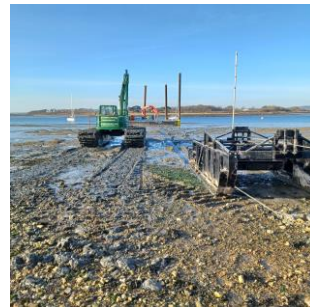
Improving the quality of Water by  
building high value ecosystems

# No regrets strategy – Unproductive land to high value ecosystems

- **Researched**
- **Financed**
- **Permitted**
- **Delivered**
- **Monitored**
- **Maintained**



Closed landfill  
Low margin land  
Wetlands  
Woodlands  
Wildflower meadows



Intertidal area  
Saltmarsh



# The Challenge



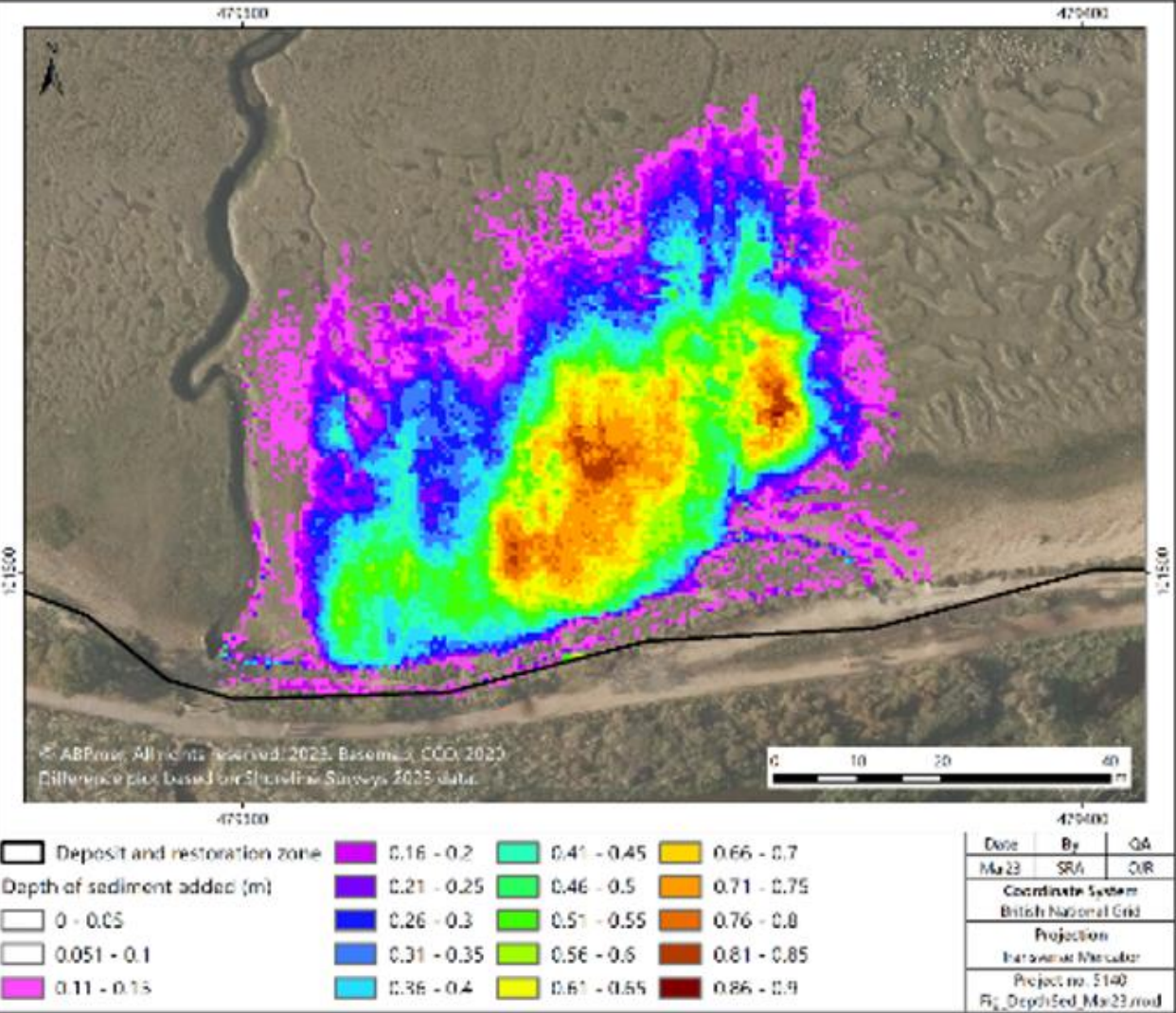
# The Approach



# Our Role



# The results



# Opportunities – for saltmarsh restoration

22,000hectares v's 55,000sq miles



The benefits

- 75% of marine life spend time in wetlands
- Nitrate absorption
- Phosphate absorption
- CO2 sequestration
- Living flood defence (storm and erosion)
- Biodiversity Net Gain
- Buffering the effects of sea-level rise
- Beneficial reuse of waste (obviating disposal at sea)
- Visual stimulus
- Green and Blue Prescriptions

Innovative automation driven Nature-based Solutions looking for new markets

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# 3

## Nature Based Solutions

### Natural Infrastructure

Preserving drinking water  
quality with Nature Based  
Solutions in St Lucia  
**Mott MacDonald**



Richard Noakes  
Technical Director

[Richard.Noakes@mottmac.com](mailto:Richard.Noakes@mottmac.com)



# Natural Infrastructure in St Lucia and Derbyshire

## St Lucia

Nature based solutions for catchment management

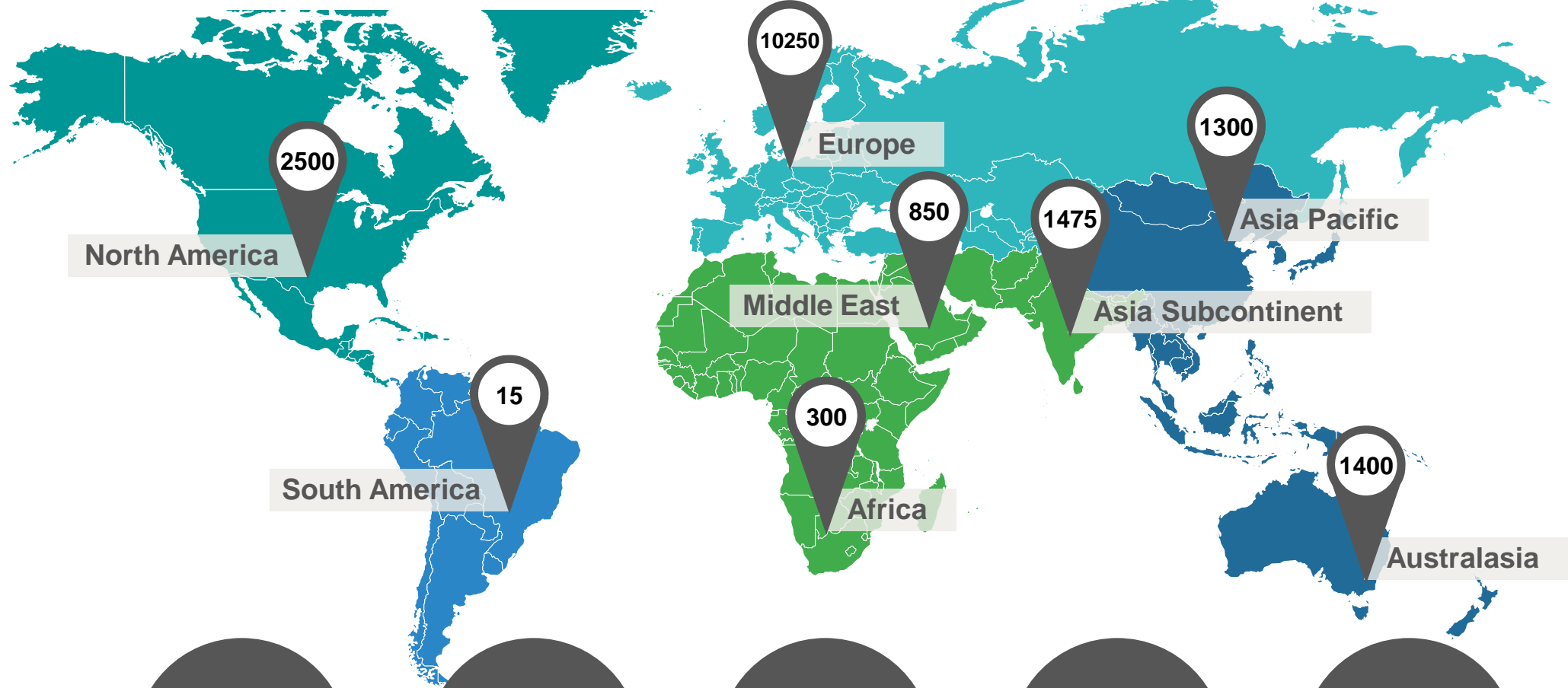
## Derbyshire

Floating wetlands for preliminary water treatment

Richard Noakes



# About Mott MacDonald



We work in 135 countries

170 permanent offices in 50 countries

18k staff

\$2 billion turnover

Over 150 years' heritage

# Our decision framework

Our six-step decision framework for nature-based solutions is a systematic and integrated approach through all stages of the project cycle. It aims to consider nature from the start of the project, plan for and maximise co-benefits, and increase confidence around performance, costs and maintenance.

 [Talk to us.](#)

Click on each step to explore more.

## Step 1

Establish a shared vision

## Step 2

Identify the options for nature-based solutions

## Step 3

Quantify a range of benefits from each solution and agree a preferred option

## Step 4

Finalise design and prepare for construction

## Step 5

Construction

## Step 6

Maintain, monitor, evaluate and learn

Look at what outcomes the main project or organisational key gain, social outcomes. This requires systematic stakeholder engagement. Benefits of nature accrue to various stakeholder groups and approach is suitable.

The design process and focus on the system

This requires systematic stakeholder engagement. Benefits of nature accrue to various stakeholder groups and approach is suitable.

During construction adapt working with nature. This implementation of decisions, and ongoing monitoring and evaluation of outcomes.

Collect evidence over time on performance, costs and maintenance, and apply the learning to future projects.



# St Lucia

## The challenge

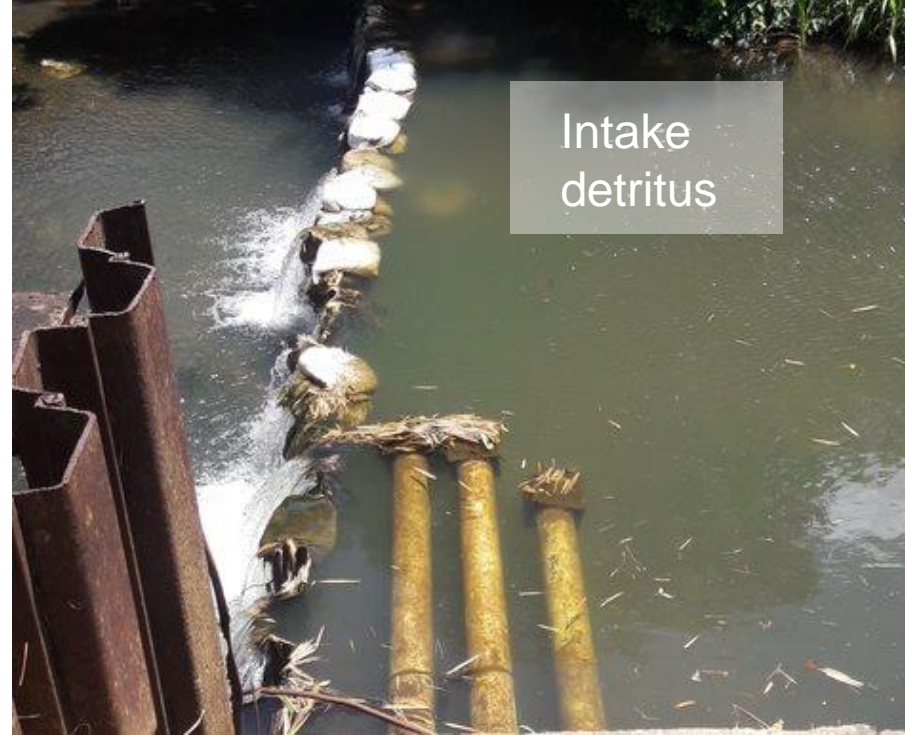
How to secure water supply to Vieux Fort ?



Upgrading treatment too expensive



Nature based solution



Intake detritus



Turbidity, poor water quality



Soil erosion

# Nature based solutions



Improved farm practices



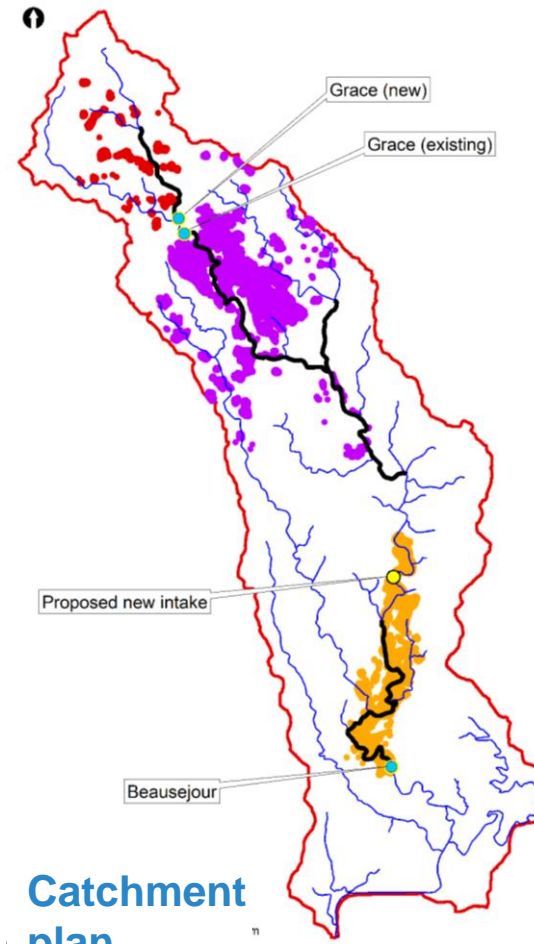
Check dams



Filter strips



Sediment retention wetlands



Catchment plan

Watershed baseline definition



Options identification and testing



Agree options with stakeholders



# Floating wetlands. Innovation in Derbyshire

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## Project

Witches Oak floating wetlands,  
River Trent

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## Client

Severn Trent Water

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## Challenge

Variable quality river water –  
need a low carbon preliminary  
treatment for potable water

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## Solution

Constructed floating wetlands  
on old gravel pits. Reduces the  
need for traditional intensive  
water treatment





Thank you

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# 4

## Digital tools for Resilience

### Remote Tools

DAMSAT – Dam monitoring by satellite reducing the risk of dam breach

Assessing Groundwater resilience Remotely

**HR Wallingford**



Juan Gutierrez  
Global Product Manager

[j.gutierrez-andres@hrwallingford.com](mailto:j.gutierrez-andres@hrwallingford.com)





Blue room:

## Module 4 -Remote tools

Case 1: DAMSAT - Dam monitoring by satellite  
reducing the risk of dam breach

Further information: Tim Hirst– DAMSAT Business Manager

[T.Hirst@hrwallingford.com](mailto:T.Hirst@hrwallingford.com)



# BRUMADINHO (BRASIL) DAM COLLAPSE

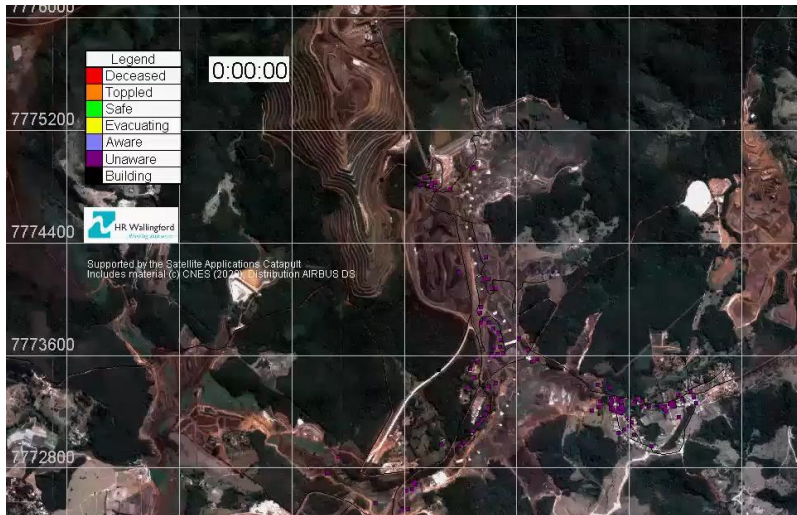
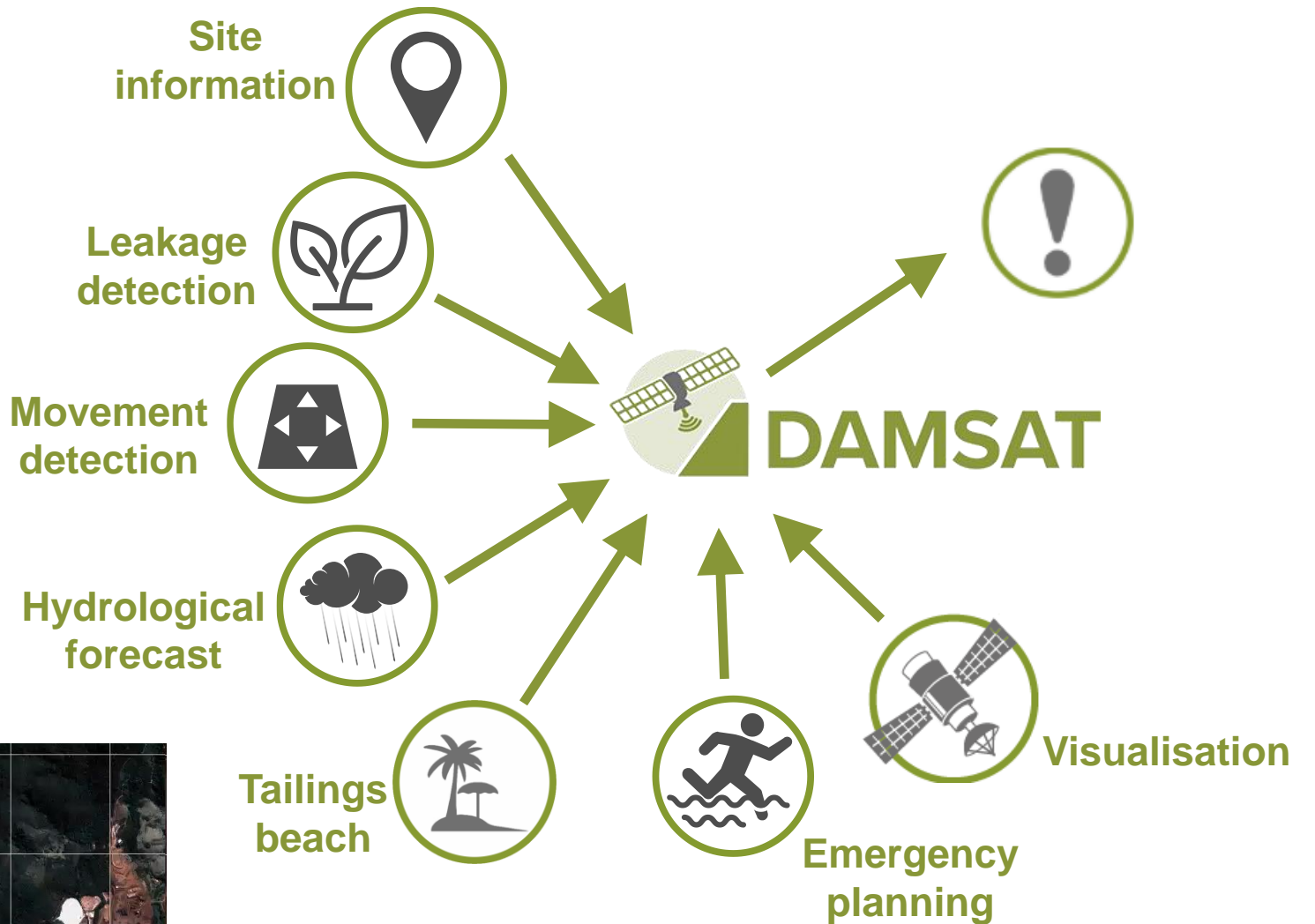
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## DURING AND AFTER COLLAPSE FOOTAGES

# DAMSAT

**Operational system to monitor water and tailings dams**

- Based mainly on satellite information
- Providing a better understanding of behaviour
- Some elements of AI and prediction



# DAMSAT REMOTE DAM MONITORING SYSTEM

**1 in 100**  
Failure rate of  
tailings dams

**31**  
Dams tested in  
Peruvian Andes



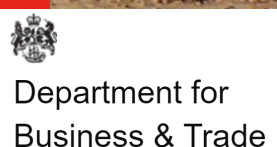
## Further information:

Tim Hirst– DAMSAT Business Manager [T.Hirst@hrwallingford.com](mailto:T.Hirst@hrwallingford.com) <https://damsat.com/>



Blue room:  
Module 4 -Remote tools  
Case 2: Assessing Groundwater resilience  
remotely (Yemen)

Further information: Andrew Ball – Technical Director  
[A.Ball@hrwallingford.com](mailto:A.Ball@hrwallingford.com)



# Challenge: the Water Crisis in Yemen

## Water scarcity

- Water scarcity is affecting food security
- Groundwater depletion major driver
- 80% of the population require some form of humanitarian assistance
- Rapid growth in number of boreholes

## Conflict

- Prevented monitoring on-the-ground
- Information on groundwater balance outdated
- Difficult to prioritise or plan interventions



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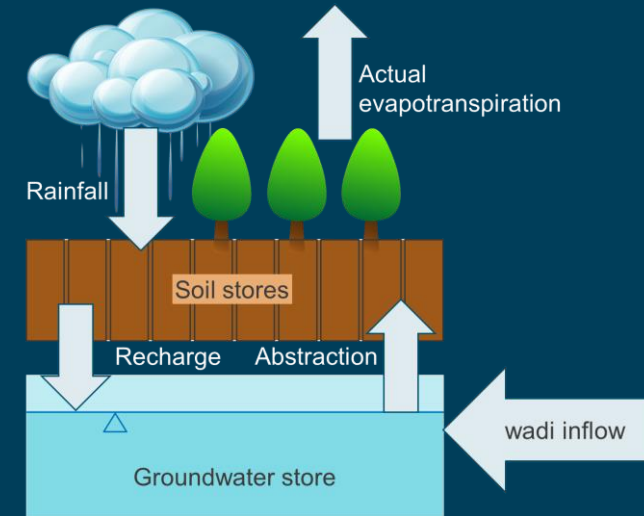
# Solution: Earth observation via bespoke web-portal

## Earth observation

- Satellite data can be used to estimate groundwater re-charge and abstraction rates
- Rainfall, landcover, evapotranspiration, population observations and derived products

## Web-portal

- Interactive resource of data for stakeholders
- Simple yet diverse in variety of information sources



Partner organisations:



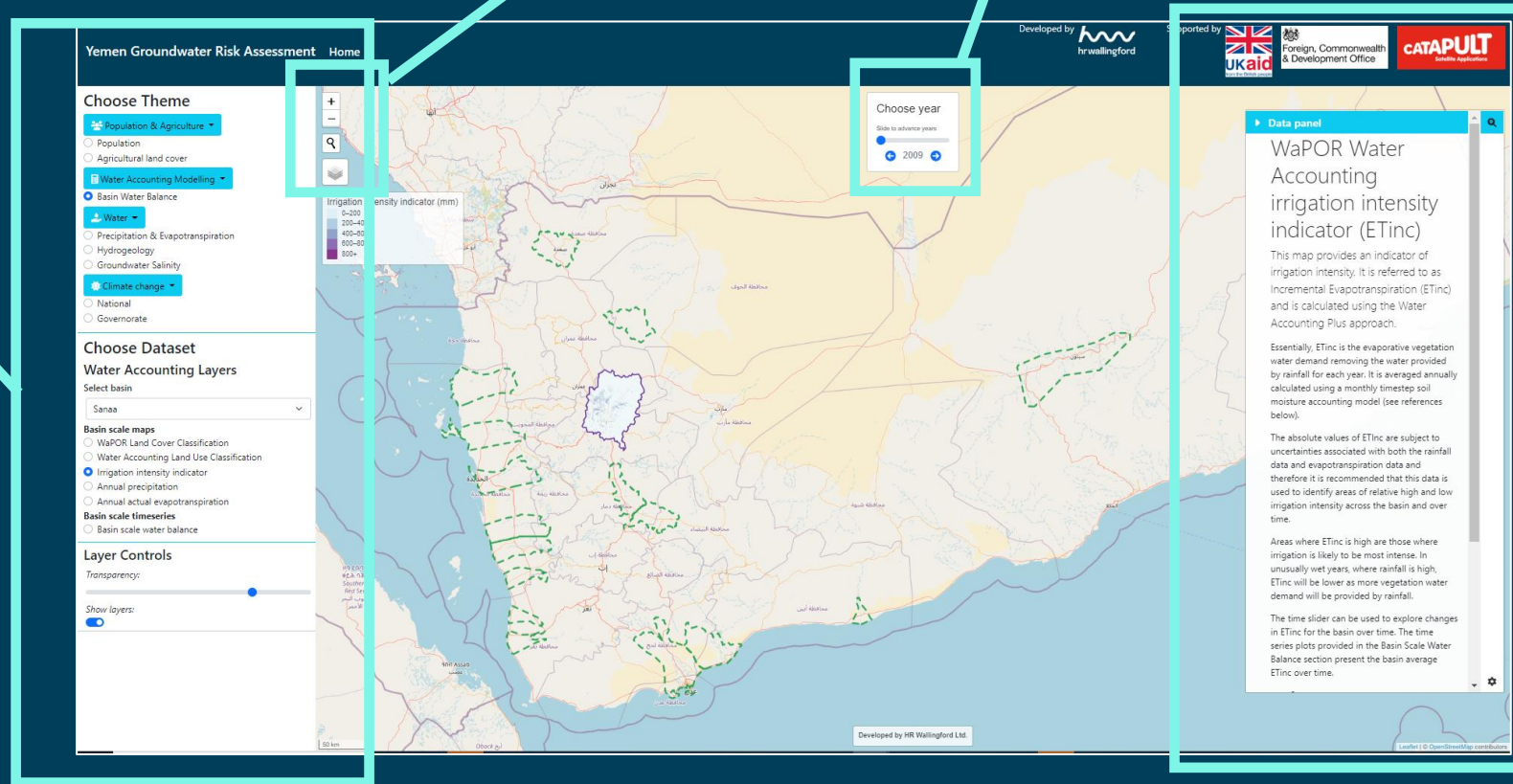
# Yemen groundwater risk website structure

Zoom, pan and switch on and off background layers

Select year of interest (water accounting modelling and agricultural landscape analysis only)

Select data of interest

Click map elements to display contextual information, charts and links



The website is based around an interactive map interface. The left panel can be used to select data based on a set of themes. The map displays data and information and if clicked a side bar appears on the right hand side which gives further information on the source, relevance to water resources and links to further information.



Further information: Andrew Ball – Technical Director

[A.Ball@hrwallingford.com](mailto:A.Ball@hrwallingford.com)

<https://www.yemen-groundwater-risk.org/>

Blue Room



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# 5

## Digital tools for Resilience

Digital tools for efficiency

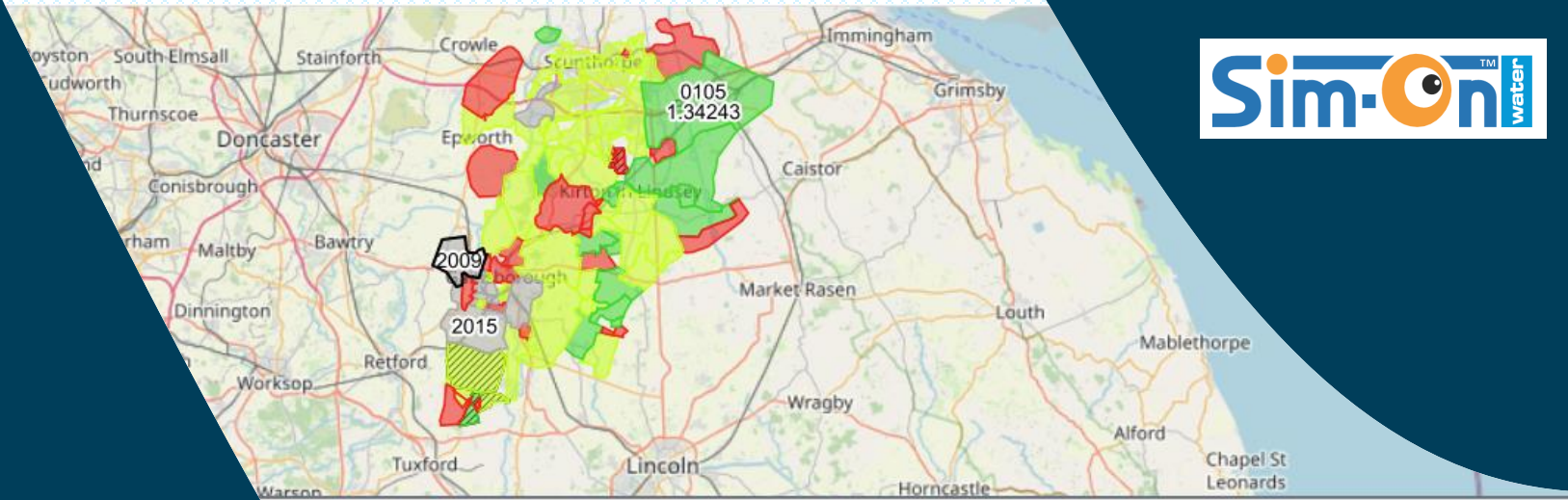
Leakage Analytics  
HR Wallingford



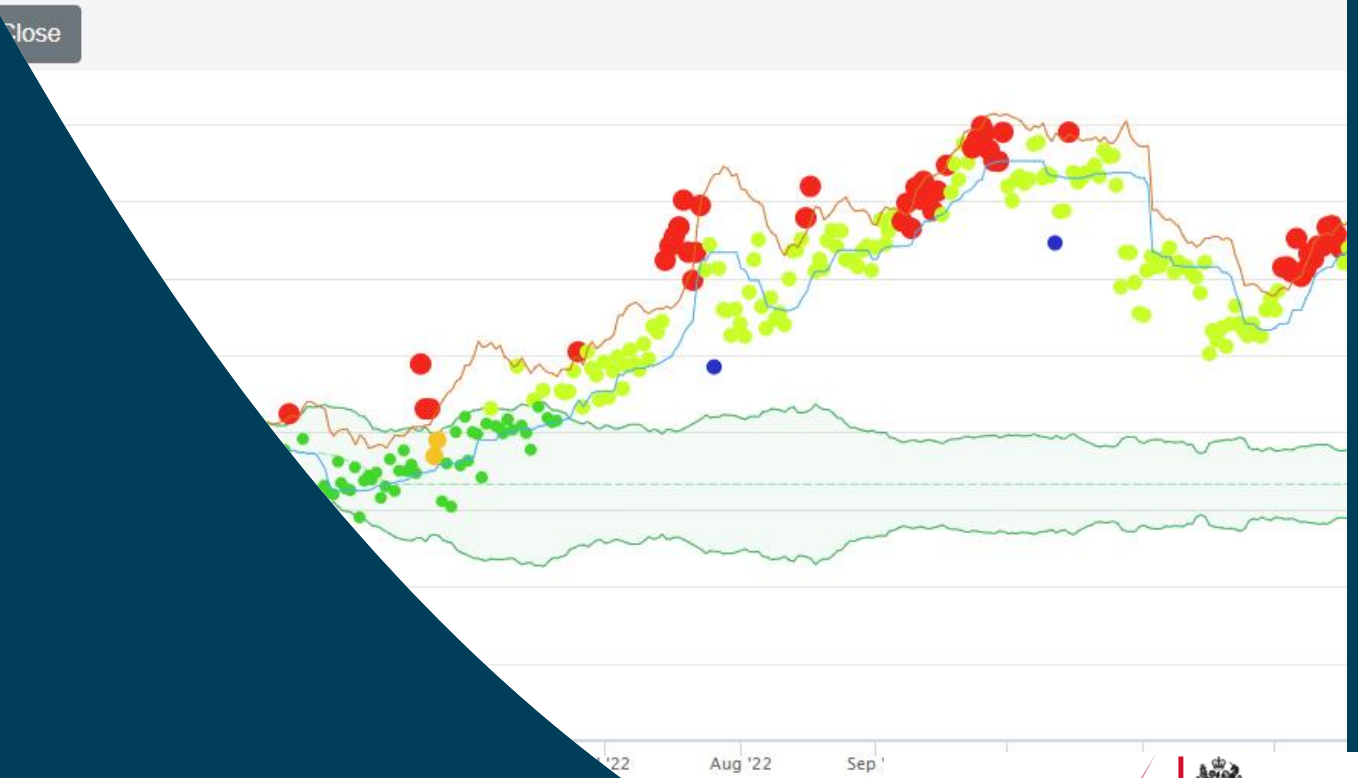
Juan Gutierrez  
Global Product Manager

[j.gutierrez-andres@hrwallingford.com](mailto:j.gutierrez-andres@hrwallingford.com)





Blue room:  
Module 5 –  
Digital tools for efficiency  
Case 1: Leakage Analytics



# It is of capital importance to reduce leakage in water supply networks but...

## Water leakage reduction

- No magic wands!

## Requires teams on the ground

- Doable but...
- Time consuming
- Very expensive
- Strategies & tools to guide the teams are essential

## It is a never-ending task

- New leakage will continue to appear
- Early detection and location are essential

## It is a complex business!

Scarce resource

Monetary cost

Waste of Energy

CO2 footprint

...

# Our contribution:



## Leakage Detector:

- Generation of an alarms when a new leakage occurs
- Provides a prioritisation at **DMA and Trunk Main** level  
(only flow sensor data needed)

## Leakage Locator:

Identification of the most likely water loss location  
(pressure sensors + hydraulic modelling)

Web based tool

Automatic

Practical

Easy to use & install

Affordable!

Supports Smart  
Meters!

Date 26/06/2023



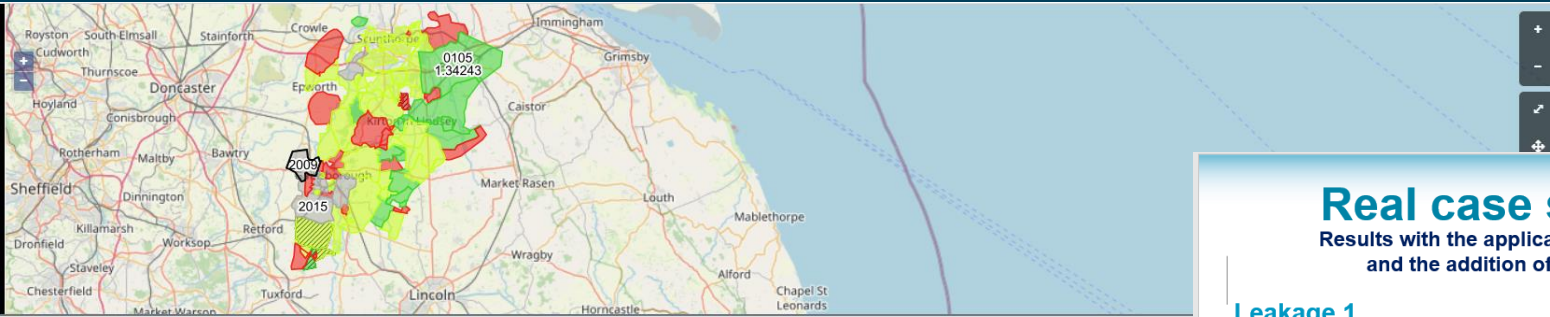
Theme

State

Areas

Zone: all

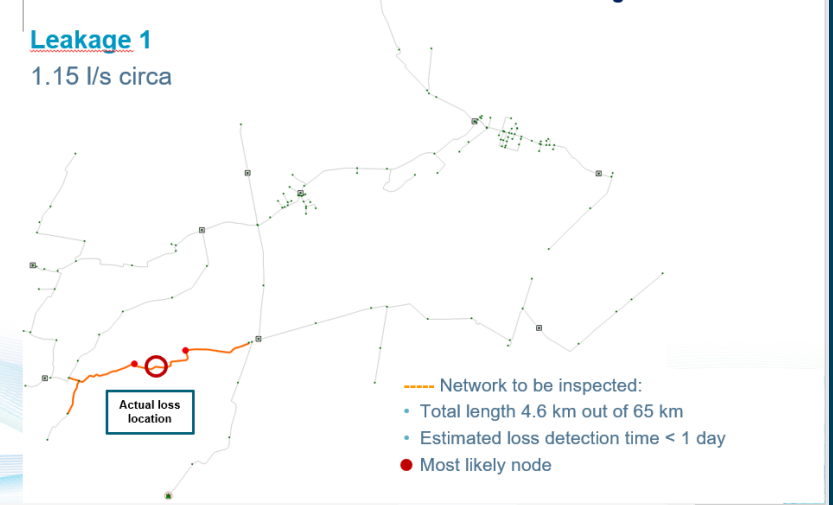
Administrator



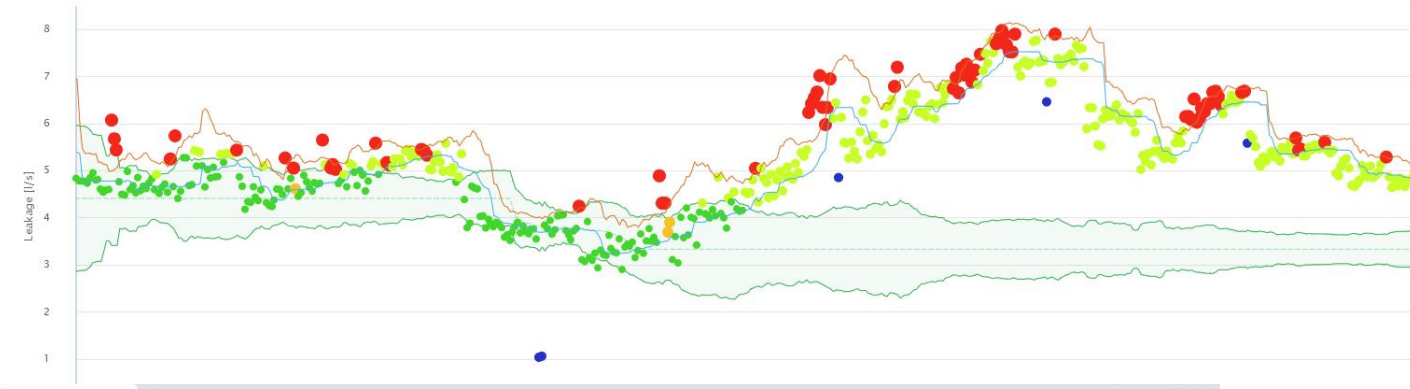
# Real case study- DMA B-1

Results with the application of the modified mathematical method and the addition of intermediate nodes on long sections

**Leakage 1**  
1.15 l/s circa



DMA 0205 leakage | Flows | Volume | Pressures | Close



Date 08/05/2022



Theme

Leakage Id

Zone: all

Administrator

DMA

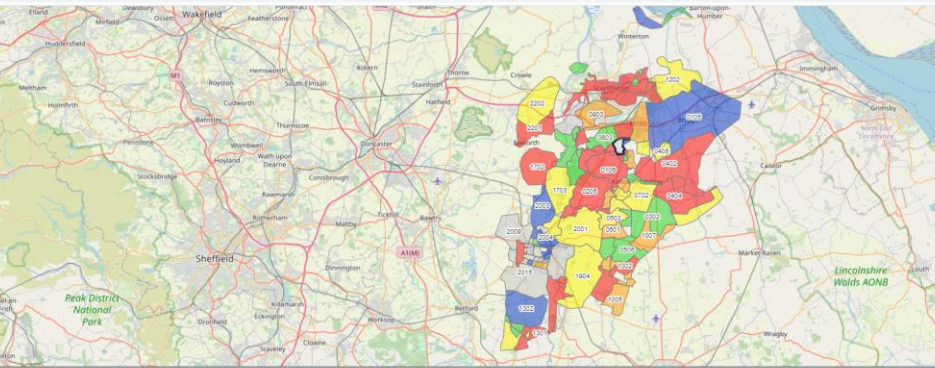
Trunk Main

Scada

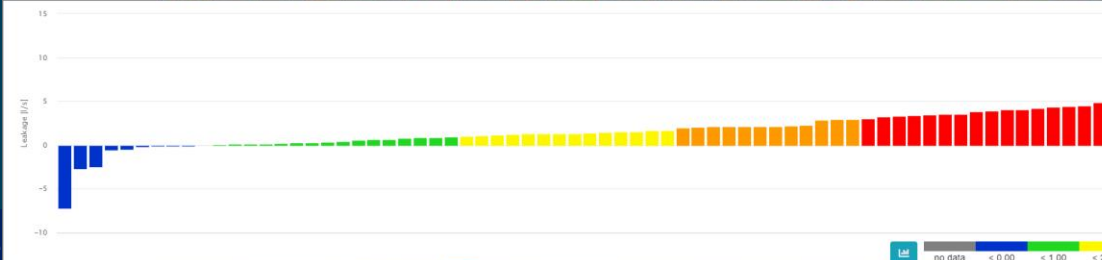
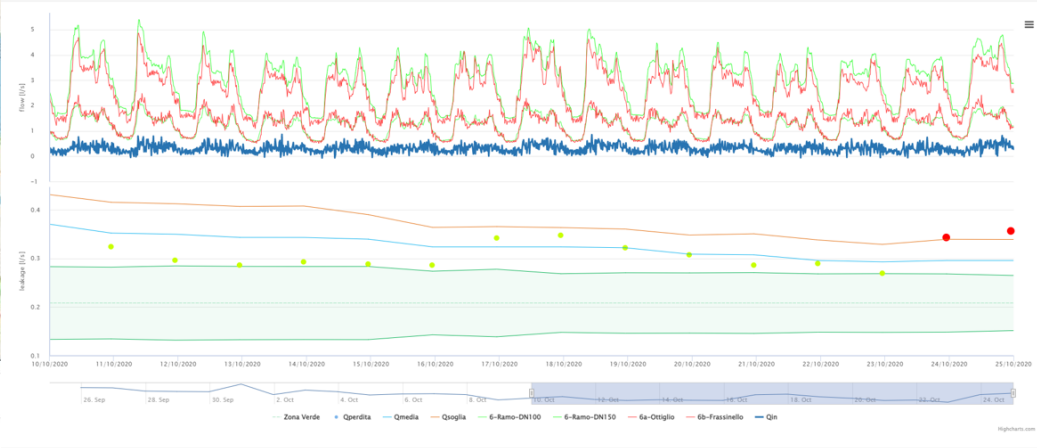
Connectors

Data Link

Settings



Trunk Main leakage | Flows | Close



45

Blue

or  
rade

# Current pilot studies



Further information: <https://simondigitaltwin.com/sim-on-water/>

Juan Gutierrez – Global Product Manager

[jga@hrwallingford.com](mailto:jga@hrwallingford.com)



Existing pilots & projects

Verbally confirmed pilots

Under discussion

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# 6

## Managing Resilient Systems

Preventive management of  
critical infrastructure

Gravity Sewer Inspection and  
condition Assessment  
**Downley Consultants Ltd**



Tom Sangster  
Managing Director

[tom.sangster@downley.com](mailto:tom.sangster@downley.com)

**D** **OWNLEY**  
**CONSULTANTS**





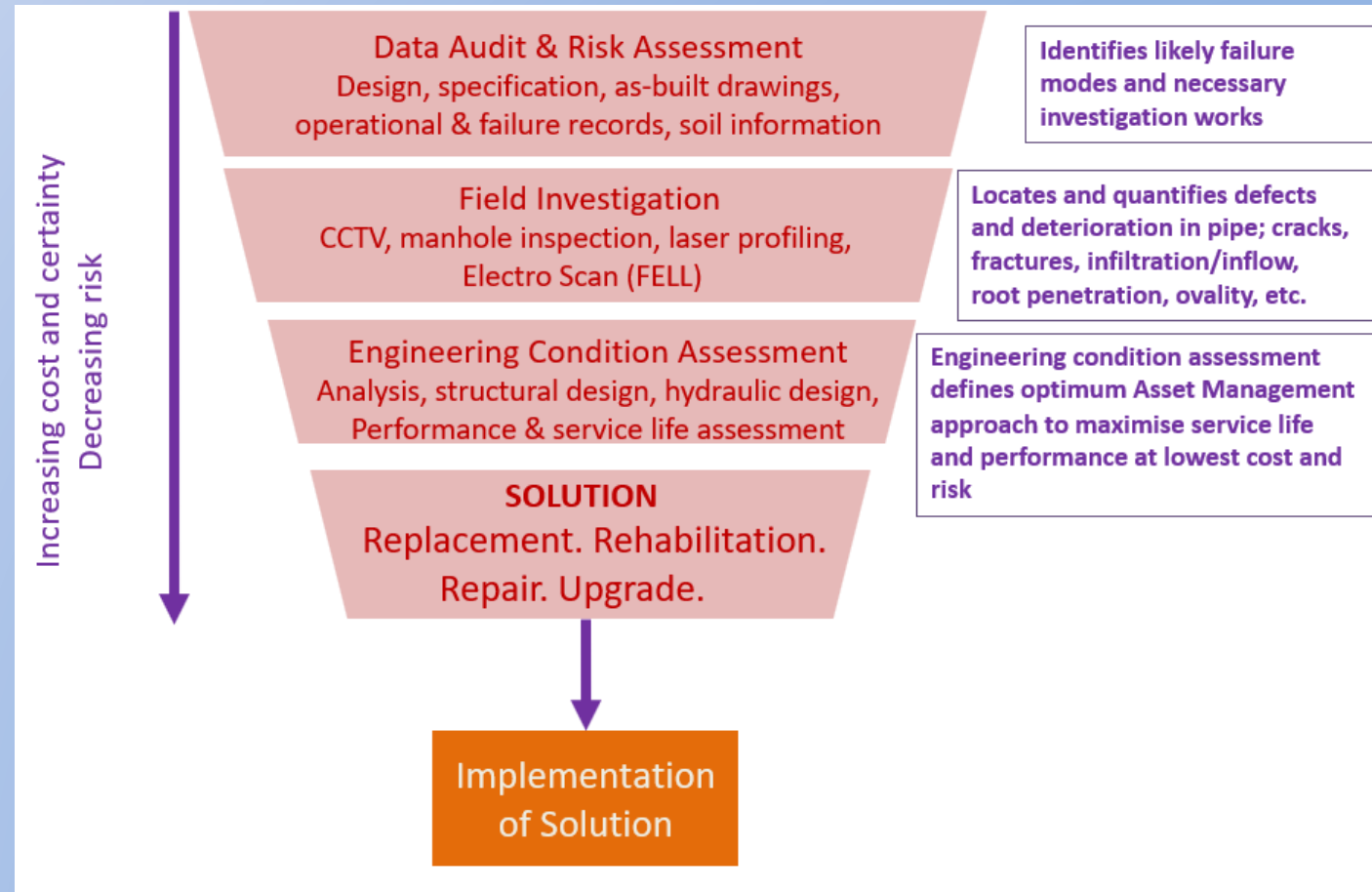
# Gravity Sewer Inspection & Condition Assessment A Case Study

Winchester, England  
+44 1962 828 712  
[info@downley.com](mailto:info@downley.com)  
[www.downley.com](http://www.downley.com)

Downley Consultants is a business and engineering consultancy focused on two dynamic and growing fields of civil engineering: geosynthetics, and underground pipe network assessment and rehabilitation.

In the underground pipe network sector we provide our clients with professional engineering expertise on investigation, condition & performance assessment and development of trenchless rehabilitation & replacement solutions to restore network performance and extend service life.

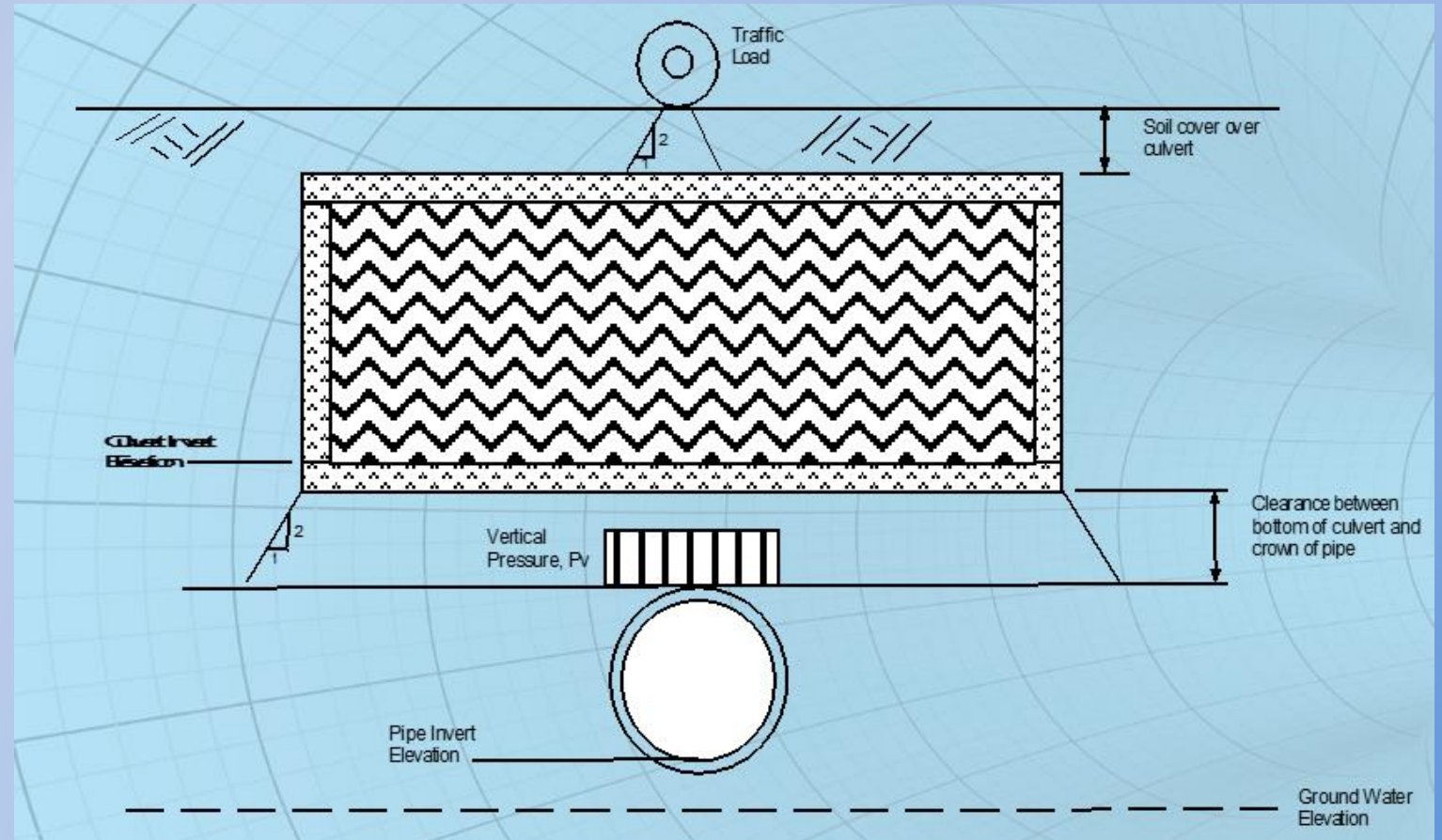
Downley Consultants operates worldwide from its UK office.



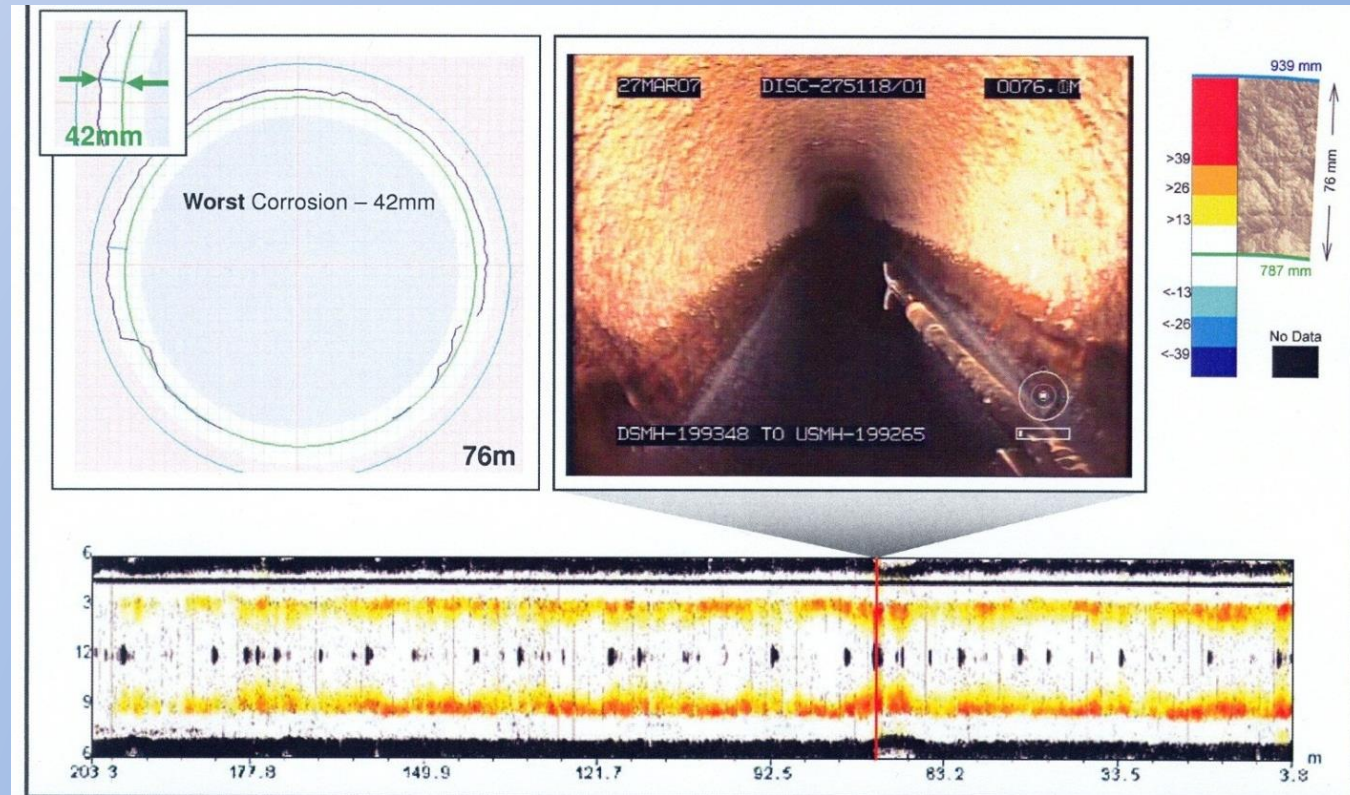
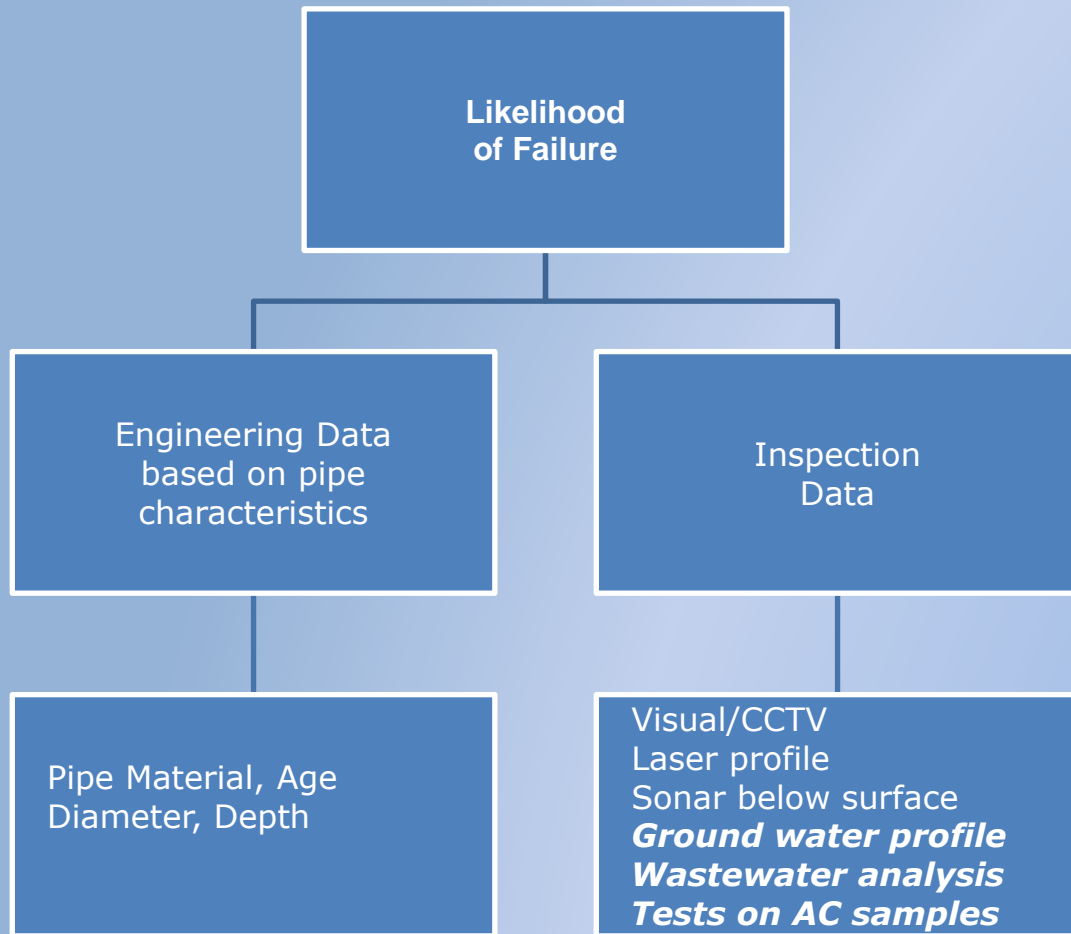
# Case Study - Batha Trunk Sewer, Riyadh, Kingdom of Saudi Arabia

- Major trunk sewer in centre of Riyadh serving large area including Ministries
- Runs below major highway and several intersections
- Runs below large storm water culvert
- Failure would be catastrophic

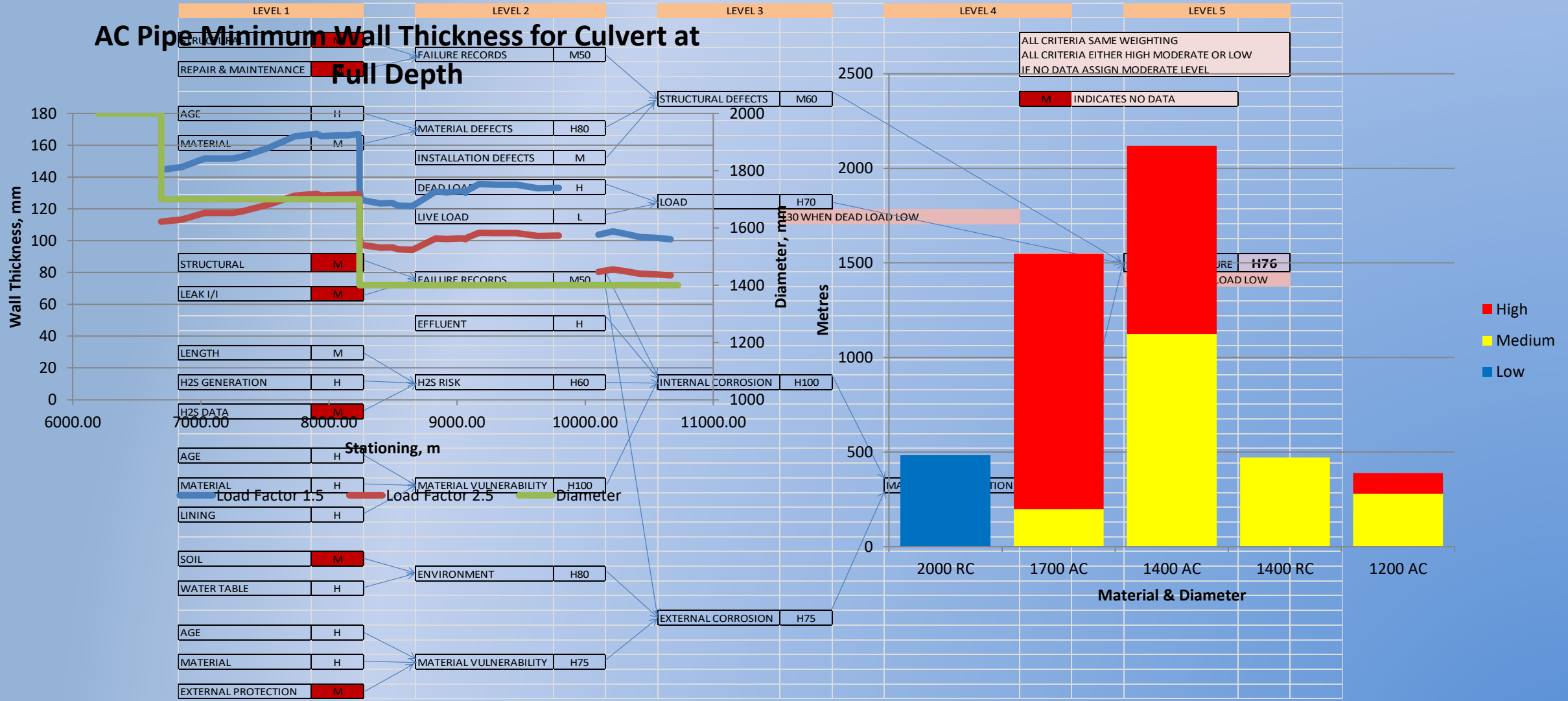
Dia. (mm)	Material	Length (m)
1200	AC	389.150
1400	AC	2119.750
1400	RC lined	471.55
1700	AC	1548.900
2000	RC lined	479.810



# Data Audit & Inspection



# Condition Assessment



# Outcomes & Recommendations

➤ Full structural rehabilitation of 1700, 1400 and 1200mm pipe; joint sealing in 2000mm pipe

➤ Full structural rehabilitation of 1700mm pipe; partial structural rehabilitation of 1400 and 1200mm pipe; joint sealing in 2000mm pipe

➤ Maintenance and monitoring

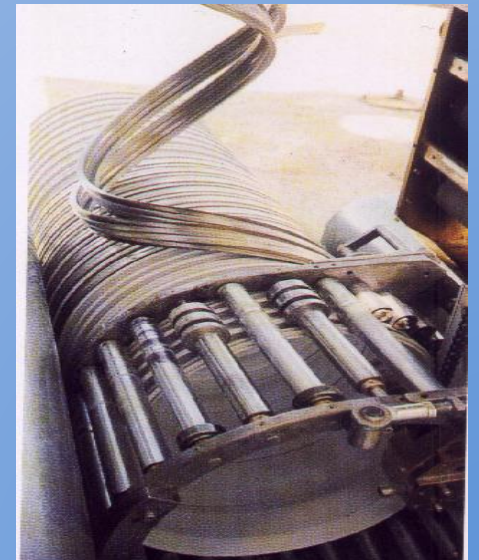
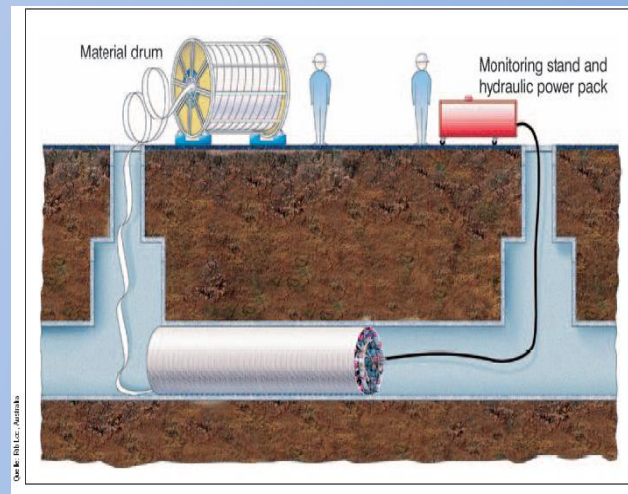
➤ Further investigation to provide better data for a more accurate risk analysis - especially actual wall thickness data

➤ Do nothing

➤ Full structural rehabilitation of 1700, 1400 and 1200mm diameter pipes

➤ Joint sealing in 2000mm pipe

➤ Rehabilitation method - spiral lining with grouted annulus



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- 6 09:15 - 09:30 Managing Resilient Systems
- 7 09:35 - 09:50 Managing Resilient Systems

## Red Room

- 0 07:00 - 07:20 Welcome and Introduction
- 1 07:25 - 07:40 Planning for resilience
- 2 07:45 - 08:00 Planning for resilience
- 3 08:05 - 08:20 Flood Management
- 8:25 - 8:30 Coffee Break
- 4 08:35 - 08:50 Water Scarcity
- 5 08:55 - 09:10 Water Quality
- 6 09:15 - 09:30 Disaster Management: Reconstruction
- 7 09:35 - 09:50 Disaster Management: Preparedness

# 7

## Managing Resilient Systems

Demand Management

Non Revenue Water Practices

**WRc**



Justine Leadbetter  
Senior Consultant

[Justine.Leadbetter@wrcgroup.com](mailto:Justine.Leadbetter@wrcgroup.com)





# Non-Revenue Water

Justine Leadbetter

Senior Consultant – Leakage & Water Resources

June 2023

UKWP-DBT Water Resilience Showcase

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# About WRc



We are **dedicated staff with a range of skillsets** who care about delivering a **positive legacy in partnership** with our clients.

Our priority is **creating a better tomorrow** through helping to solve problems with technical expertise and innovative solutions.



## creating a better tomorrow

Our work as **consultants and service providers** supports the achievements of the United Nations Sustainable Development Goals (SDGs).

We are **focused on doing the right thing** – protecting the environment, reducing our carbon footprint and that of our clients, and above all ensuring safe, healthy, populations and habitats.

This is achieved through demonstrating our core values: underpinning our **trusted, innovative solutions** with **technical excellence** and **independence** of thought.



## Strategic advice

- South West Water
- Thames Water (R&M)



## Standards, Guidelines & Publications

- CESWI
- Neom



## Thought leadership

- Water UK Leakage Routemap to 2050
- Water UK Consumption Routemap



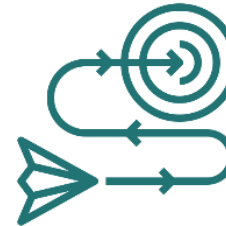
## Portfolio collaborative research programme

- CP626 ultra-low loss new networks
- CP607 Corrugated Stainless Steel Service Pipes



## Regulation

- EA, FCDO Brazil
- Ofwat
- APSR, Oman

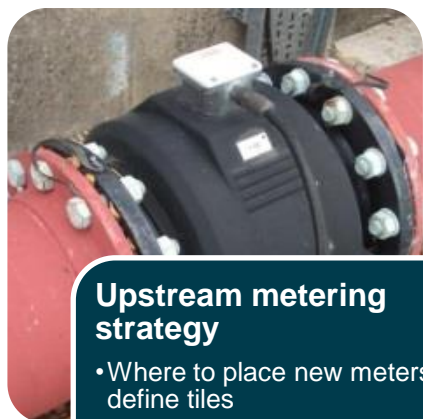


## Tactical

- Welsh Water Pressure Management
- Upstream Losses – DCWW, SW, SEW
- Forecasting – STW, WRSE

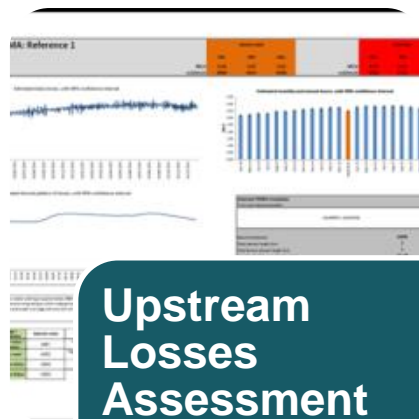


# Case Study: Do you have a **real** losses problem?



## Upstream metering strategy

- Where to place new meters to define tiles
- Making the best of existing meters
- Appropriate technologies



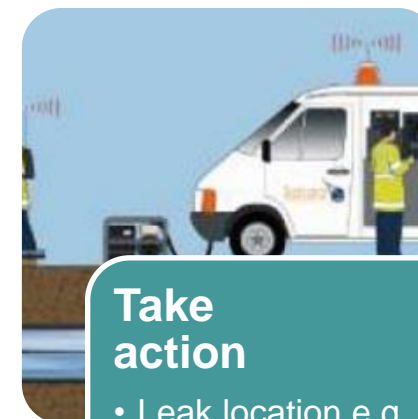
## Upstream Losses Assessment

- Database preparation
- Quality assessment and processing
- Uncertainty analysis
- Leakage estimation



## Intervention Strategy

- Recommend interventions
- Investment prioritisation



## Take action

- Leak location e.g. Sahara leak location
- Condition assessment
- Meter audit / verification / replacement



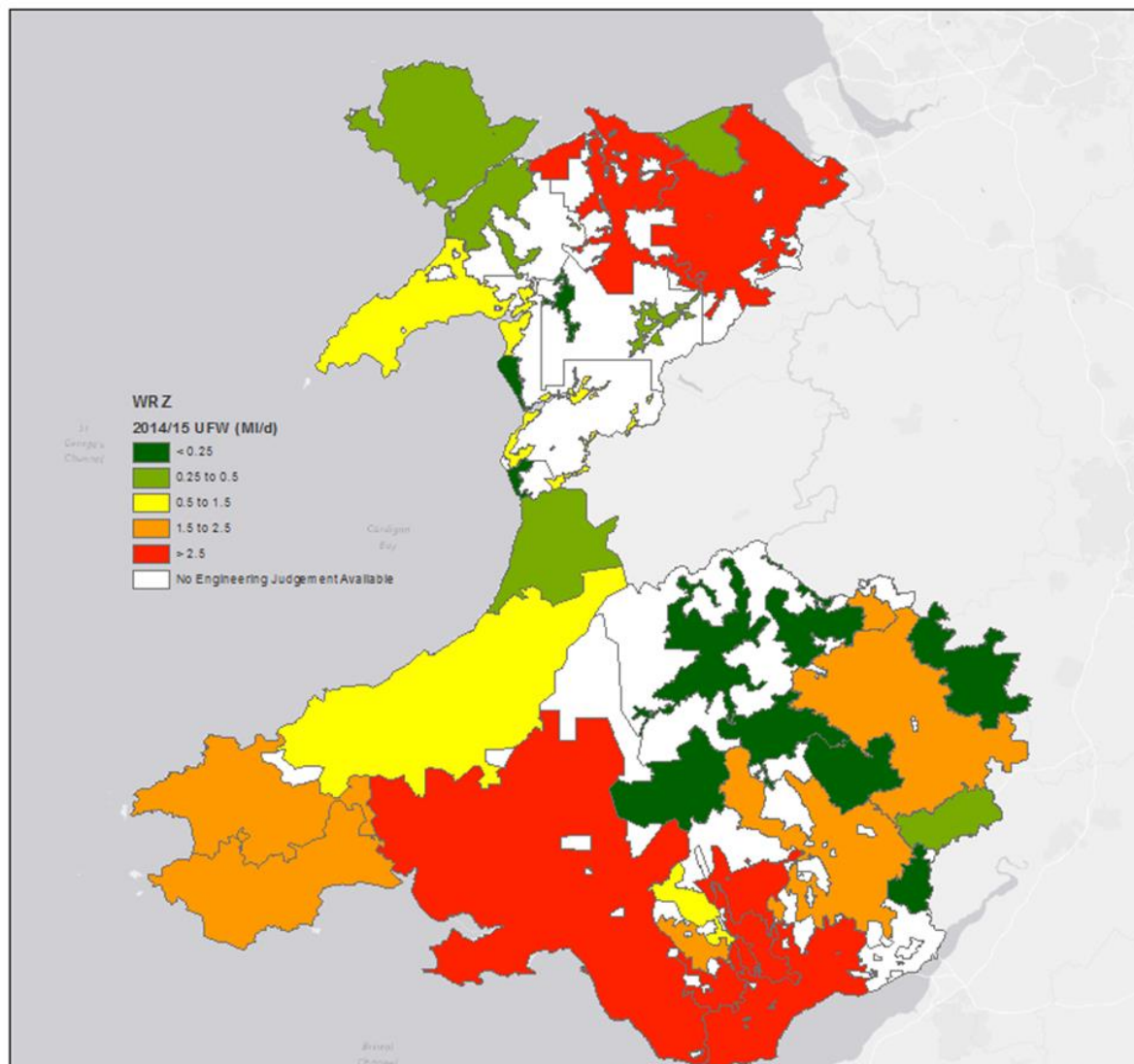
## Case Study: Upstream losses



Strategic networks thought of as the 'problem child'

### *Real or apparent losses?*

Meter under-registration a major issue, often masking leaks or masquerading as genuine leaks



💧 >1 Tb of data interrogated

💧 600+ water balances produced in 6 months

💧 Intervention strategies provided for each TMA

💧 Quick wins identified (real and apparent losses) – early finds included 2 MLD on a single section of trunk main, validated by inspection.

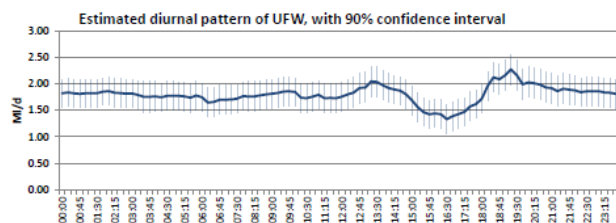
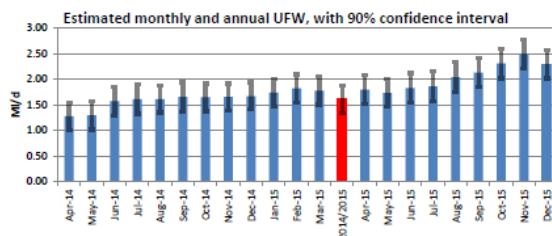
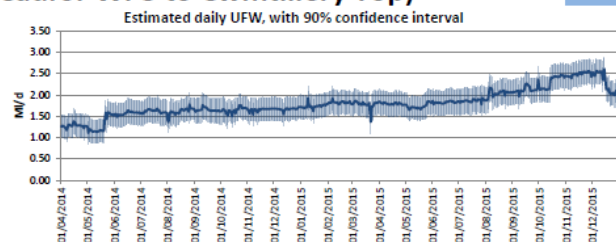


# Case Study: Upstream losses



## TDMA: (8116) 116GT004 (Cadfor WPS to Cwmtillery Top)

2014 / 2015 annual average unaccounted for water (Ml/d)	Estimated percentage UFW (of total inflow)	Data completeness
1.61	29%	100%
Min: 1.34		
Max: 1.88		



Selected TDMA metadata	
Total ferrous network length (km)	38
Average age of ferrous network (years)	77
Trunk main balance equation	
[PCSG2204] - [1CRE1702] - [1CRE6651] - [1CRE6652] - [1CRE6653] - [1CRM2001] - [1CRM2002] - [1CRM6654] - [1CSW3410] - [1LPP6601] - [1PLLCF212] - [customer demand]	
Number of network events in last 3 years	10
Total network length (km)	46
Number of households	172
Number of non-households	46

**COMMENTARY:** One inlet is pumped, data looks ok. Shift in regime causes spikes in residual but average out over day. No clear reason why the residual is rising, or why it steps down in December 2015, other than growth in background (real) losses. Minor outlets have periods where they have no flow data recorded - totalling around 0.2Ml/d. [1CRE6651] is a Kent 3000 and appears to be operating in the low end of range and stalling. This should be replaced, although almost negligible for balance (0.05Ml/d recorded). [1CRE6652] and [1CRM6654] are both Kent 2000 meters which appear to be operating in the low end of the range and therefore probably have high uncertainty around the readings. Verification should be carried out on these. [1LPP6601] has a lot of data at low flows and could be under reading; there are odd higher readings; meter should be replaced. Noted that records suggest 2.4km of very old 16" steel network plus 2.1 km of 1" very old galvanised iron and 1 km of 6" 42-year old spun iron. This mix of materials and ages suggest an aging ferrous network in potentially poor condition which requires further ALC followed by targeted internal inspection to narrow down leak locations and best candidate lengths for future lining or replacement.

No.	Intervention	Relevant Asset	Evidence trigger	Evidence source	Relationship to UCD	Estimated cost
1	Replace meter	1CRE6651	Kent 3000 meter operating in low end of range	Meter review	WRc estimate - capex	£1,000.00
2	Replace meter	1CRE6651	Kent 3000 meter operating in low end of range	Meter review	WRc estimate - opex	£2,000.00
3	Verify meter	1CRE6652	Kent 2000 meter operating at low end of range	Meter review	Meter verification	£182.16
4	Verify meter	1CRE6654	Kent 2000 meter operating at low end of range	Meter review	Meter verification	£182.16
5	Replace meter	1LPP6601	Kent 3000 meter with most readings at very low flows	Meter review	WRc estimate - capex	£1,000.00
6	Replace meter	1LPP6601	Kent 3000 meter with most readings at very low flows	Meter review	WRc estimate - opex	£2,000.00
7	ALC	16inch steel pipe; 6" spun iron; 1" galvanised iron	Rising residual, aging unlined ferrous network	Balance workbook, GIS	27km: 2 man team, 8 hour day x 5 days @ £26.15/man-hour	£2,092.00
8	In-pipe condition assessment / leak detection	16inch steel pipe	Rising residual, aging unlined ferrous network	Balance workbook, GIS	WRc estimate - based on 24km inspection with in pipe inspection method (e.g. WRc Sahara or SmartBall)	£150,000.00

- Clear upward trend observed in residual, even allowing for meter errors.
- Recommend several old meters be replaced.
- Recommend ALC on steel and spun iron network.
- Recommend targeted internal inspection of 16-inch steel pipework.

# Thank you

Whether you are a multi-national corporate, a regulated utility company, a government department, a contractor or an independent technology developer or supplier, our team will work with you to deliver exceptional service and create valued solutions for your needs.

If you would like more information about any of our products or services, or have a question, please do not hesitate to get in touch with Justine Leadbetter ([Justine.Leadbetter@wrcgroup.com](mailto:Justine.Leadbetter@wrcgroup.com)) and we will get back to you promptly.



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Blue Room

# wrc

creating a better tomorrow

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Business & Trade

# Thank you for joining us



## Please give us your feedback!



# UK WATER PARTNERSHIP

## Water Resilience Showcase

28 June 2023

30 June 2023



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