# Moving Material – Hydraulic Management of Water Quality

Reinar Lokk[1], Stewart Husband[1], Joby Boxall[1], Michele Romano[2]

[1]University of Sheffield – [2]United Utilities

W♦TER INFRASTRUCTURE AND RESILIENCE WIRe

EPSRC Centre for Doctoral Training

Water leaving treatment works has 99.95% compliance

Quality deteriorates as it travels through DWDS

An event causes out of ordinary flows and causes deposited material to mobilize

- **Drinking water discolouration is the greatest cause of customer complaints for water quality issues.**
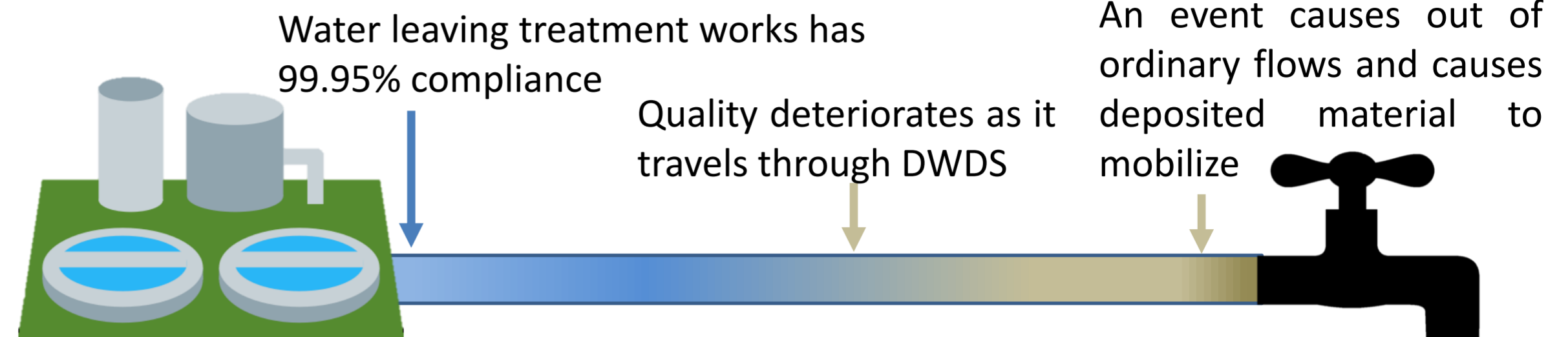
Potable water leaving treatment works is under strict regulations by UK Drinking Water Inspectorate but still, has high compliance (DWI, 2018). However, drinking water quality tends to decline inside the extensive distribution system. UK regulations set out 1 NTU at treatment works but allow 4 NTU at customer taps. This indicates allowance for potential water deterioration within the distribution system. Discoloured water occurs when particles that have accumulated inside drinking water pipes become mobilised in large quantities resulting in (dis)coloured water. Discolouration is used as a performance indicator for UK water companies with significant financial rewards and penalties.

Discolouration

- **Research has shown that around 70% of discolouration contacts originate from DMAs – pipes close to the customer.**

Alongside the omnipresent cohesive material layers, there could be certain areas where particles accumulate as loose deposits (Husband and Boxall, 2018). If mobilised these sediments can result in severe discolouration events. The processes causing this excessive material accumulation within DMAs remain unclear. In addition, the conditions that allow loose deposits to form or re-suspend have not been confirmed.

1,811,121
CUSTOMERS AFFECTED BY DISCOLOURATION (IN UK IN 2020)

Is sedimentation by gravitation a potential cause?

If so, how do we identify where it occurs within DMAs so strategies can be developed to mitigate these discolouration events? Many water companies take a very crude and reactive (rather than proactive) approach with discolouration complaints without having much insight and understanding of the troublesome areas. The goal is to manage the drinking water network in a way that avoids discolouration at customer taps (reduced contacts).

- ❖ **Three approaches will be used to investigate hydraulic sedimentation behaviour:**

Moving Material! Hydraulic Management of Water Quality

Lab Trials — *To investigate settling hydraulics.*

Modelling — *Use data from experiments to identify sedimentation areas in DWDS.*

Field Work — *Use data from experiments to identify sedimentation areas in DWDS.*

Reduced interventions, lower discolouration risk / improved service

- ❖ **Significance**
  - ✓ Reducing discolouration requires an understanding of the processes leading to discolouration in DMAs.
  - ✓ Knowing the hydraulics that influence sedimentation could lead to new water quality design principles.
  - ✓ Improved knowledge of accumulation can inform discolouration maintenance strategies making them more efficient.
  - ✓ New hydraulic modelling methods can improve the accuracy of DWDS models.

- ❖ **Current Work in Progress:**

➢ Investigating cohesive sedimentation theory. According to conventional mathematics, individual particles should not be able to settle in drinking water distribution systems. This method hopes to explain sedimentation by including potential flocculation of cohesive particles.

➢ Studying the impact of modelling every household with high-frequency demand patterns. Demand profiles are often taken as 15-minute average. Also, current hydraulic models use grouped demands. Because of this hydraulic information is lost. The use of unique individual stochastic demands could provide a reliable method to apply bottom-up modelling.

➢ Laboratory trials are being prepared to test hydraulic conditions which allow material to settle in DWDS.

United Utilities Water for the North West

The University Of Sheffield.

UKRI Engineering and Physical Sciences Research Council