

Taking the "chance" out of microbiological monitoring of drinking water

Leila Claveau, Neil Hudson, Paul Jeffrey, Francis Hassard

Stream

The Industrial Doctorate Centre for the Water Sector

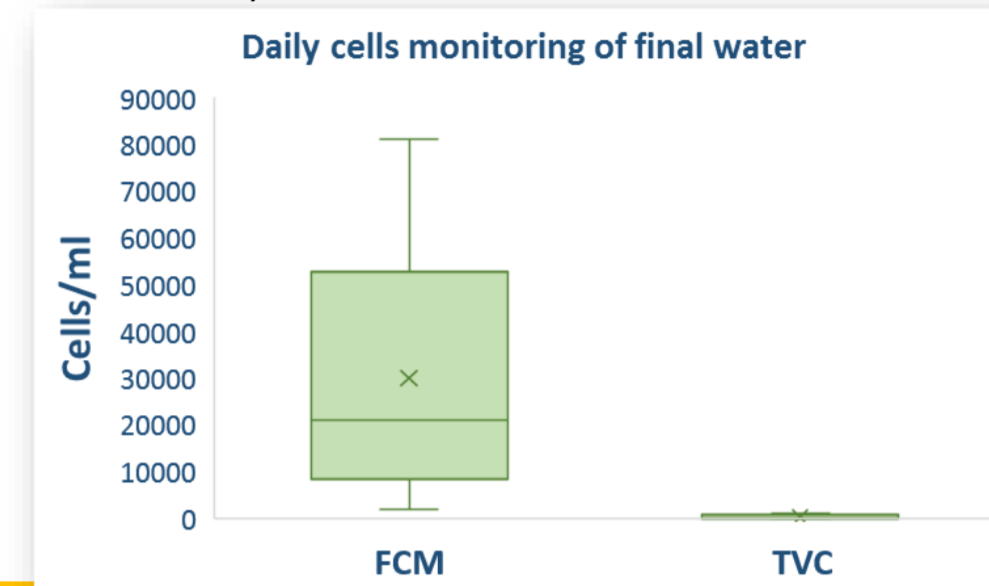


BACKGROUND

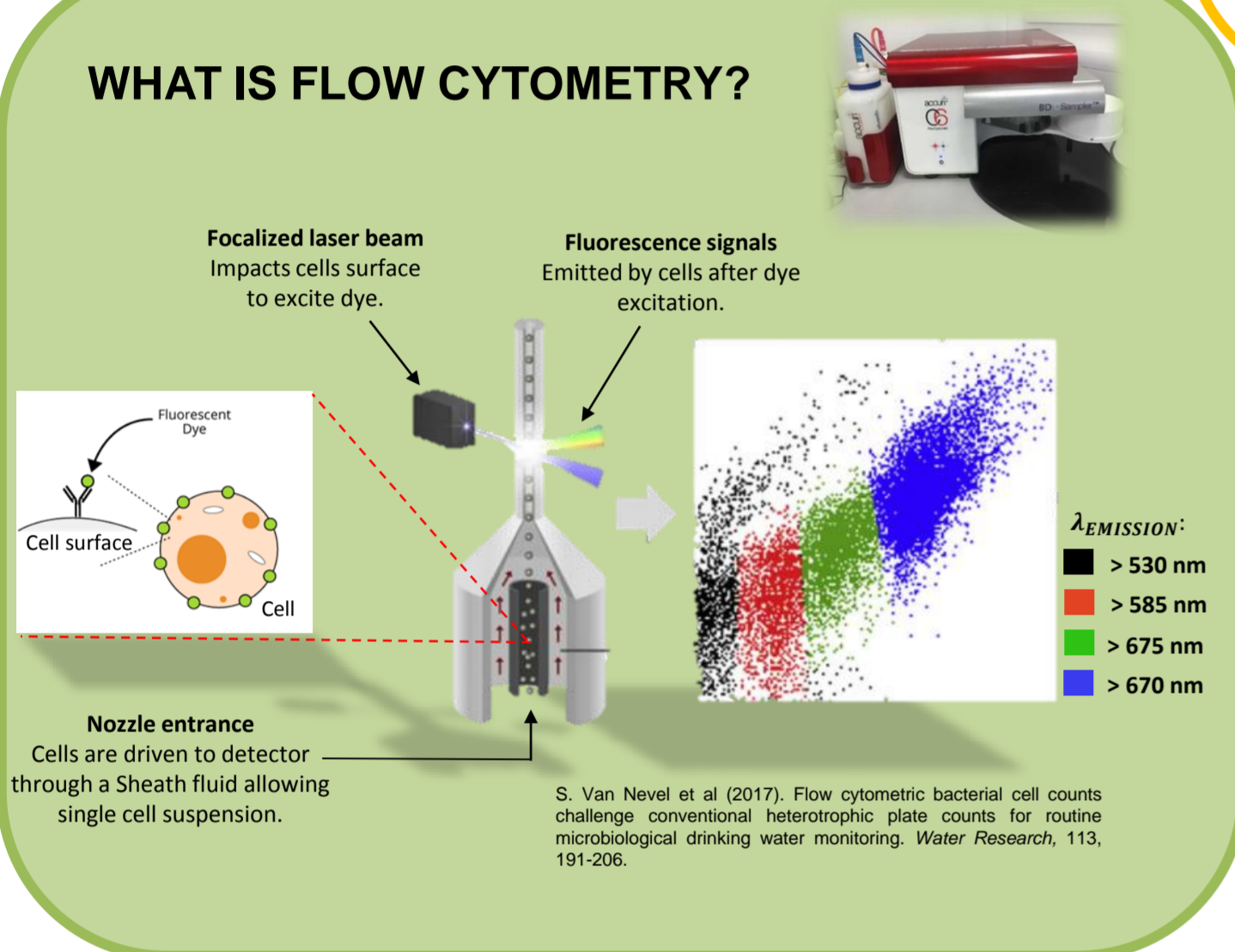
To maintain bacterial quality of drinking water, industries employ current culture-based methods such as Total Viable Counts (TVC). However, these methods are reported to represent only 1% of the total bacteria. Furthermore, assets for controlling bacterial populations like contact tanks are not optimised for cell (bacteria) removal. Indeed, they tend to serve functions with respect to water treatment (e.g. coagulation, oxidation, etc). Therefore, stated log change in intact cell numbers rarely meet requirements outlined by the WHO (typically 4-8 log cell removal).

HYPOTHESIS

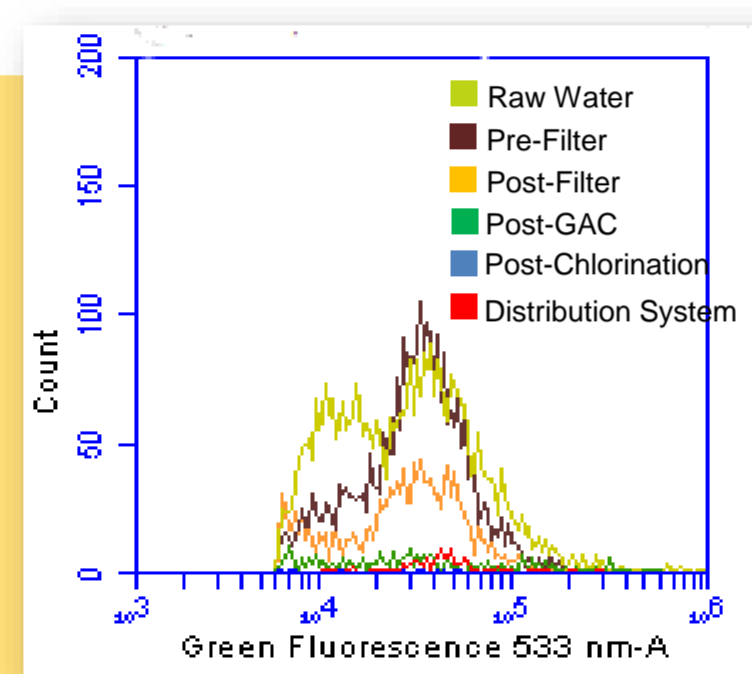
Flow cytometry (FCM) is a recent and widely adopted technique in the water industry. It has the benefit to allow measurement of total and intact cells present in water. Understanding the role of FCM in optimising chlorine inactivation (contact tank) and suppression of growth through residual (distribution) is a key knowledge gap. This study compares the daily efficiency over four years of a water treatment work at every treatment stage to better understand the vital asset for cell removal.



WHAT IS FLOW CYTOMETRY?



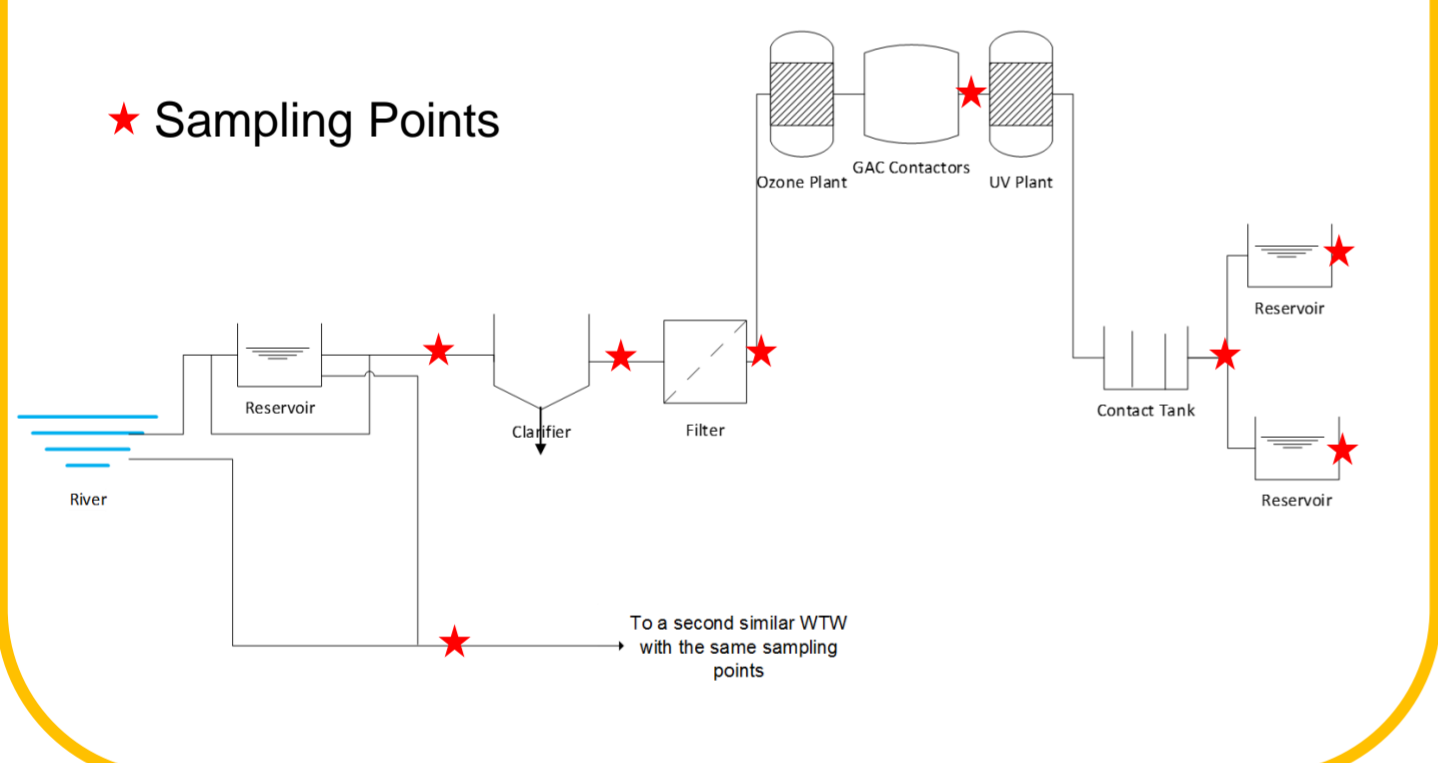
RESULTS



Fingerprint

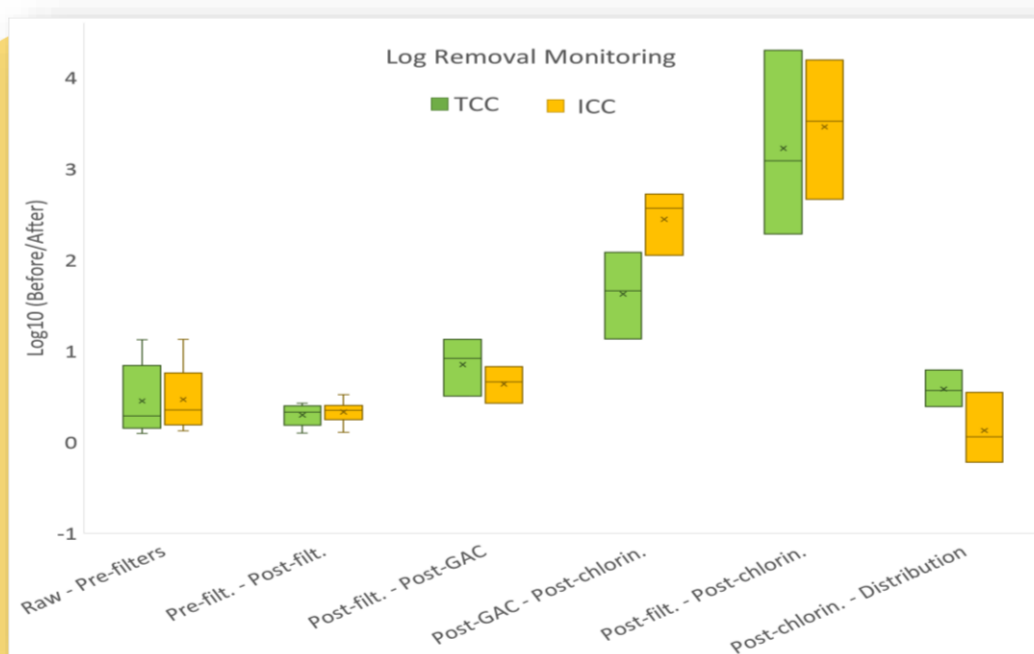
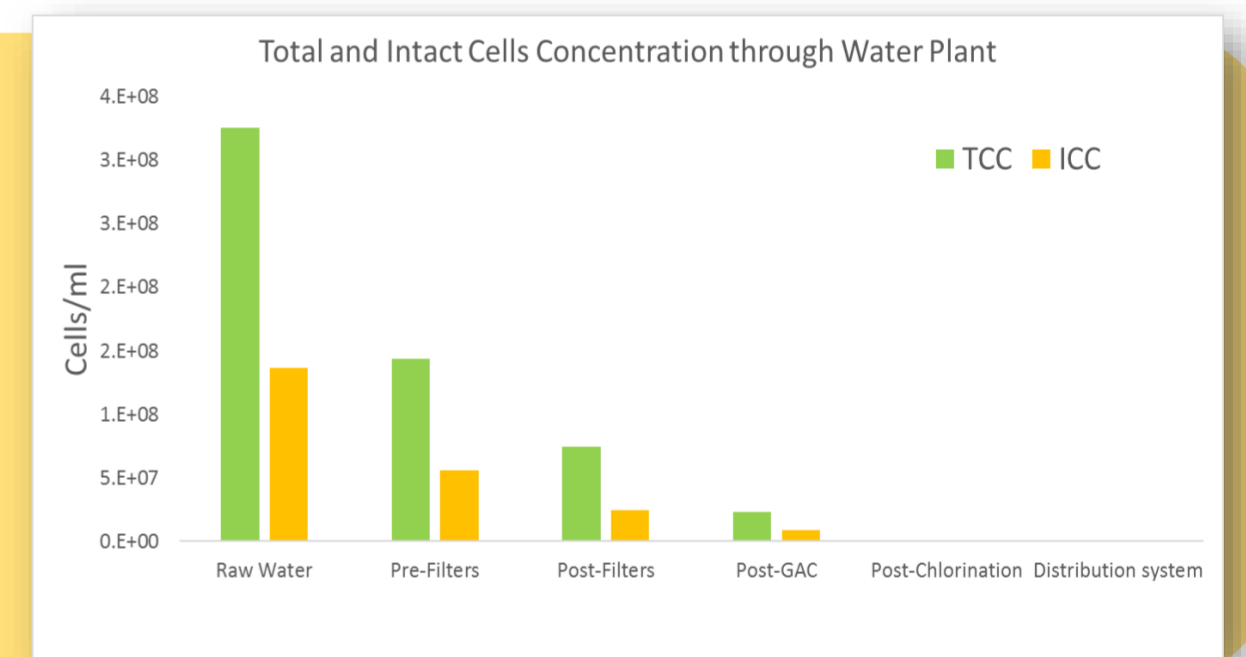
FCM allows a cell distribution based on High Nucleic Acid (high fluorescence) and Low Nucleic Acid (low fluorescence). Therefore, it is used as a fingerprinting method to detect shifts within a microbial communities in drinking water. Thus, changes caused by changing environmental factors can be detected.

STUDIED WATER TREATMENT WORK



Total and intact cells

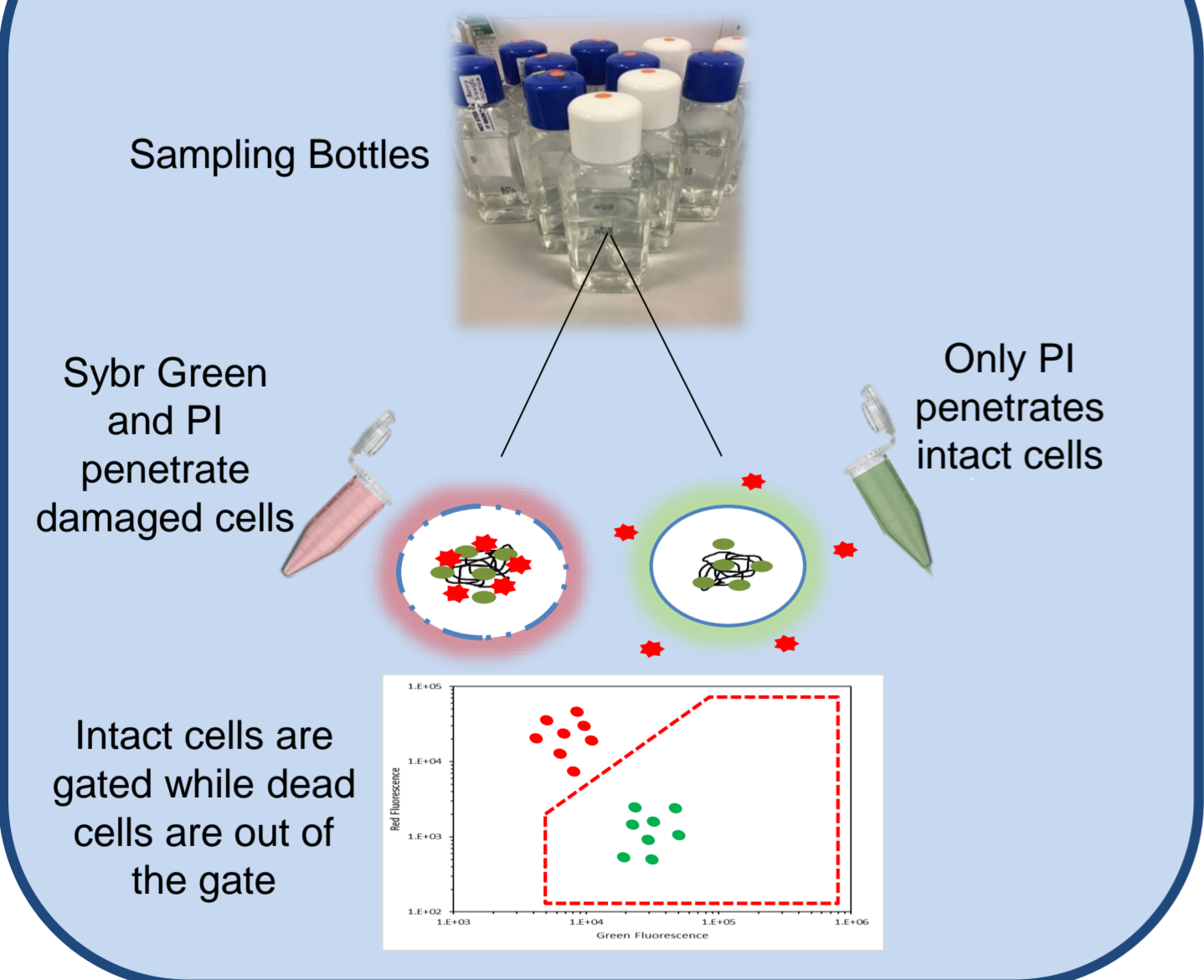
FCM enables the assessment of microbial growth in the drinking water distribution systems. Consequently, it can prevent risk of failure as high intact cells concentration was reported to be linked to compliance failures.



Log removal

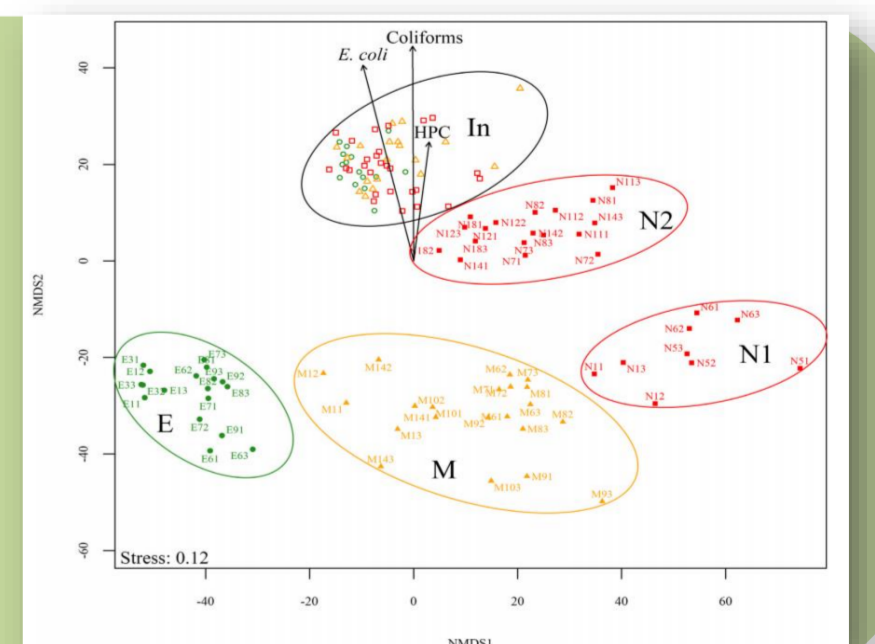
FCM can be used as an early-warning tool to control processes through drinking water networks. It allows an online monitoring of full-scale water treatment plants by observing logarithm removal graphs. The closer to 4-8 log removal, the more WHO requirements are met.

STAINING METHOD



CHIC

CHIC is a tool to evaluate huge datasets within very short time frames in order to visualize cell population or community dynamics and to suggest causes of dynamic variations. In contrast to the conventional tool, CHIC doesn't require gate setting procedures and it doesn't rely on quantification and binning of event distributions.



S. Chan et al (2018). Monitoring biofilm function in new and matured full-scale slow sand filters using flow cytometric histogram image comparison (CHIC). *Water Research*, 138, 27-36.

OUTPUTS

Unlike the conventional methods, Flow Cytometry promises many benefits such as time-saving, reduced costs and a better understanding of failure causes. In addition to FCM, Cell Sorting method will also be applied to this project in order to identify individual species and provide accurate concentration. This method reveals the diverse bacterial community present in drinking water and its origin.

ACKNOWLEDGEMENTS

The authors express their gratitude to Richard Brown and Marcus Bedford for assistance in the laboratory.

www.stream-idc.net

For further information: leila.Claveau@cranfield.ac.uk

Postal Address: 3 Columbus Drive, Farnborough, GU14 0NZ

south east water



EPSRC
Engineering and Physical Sciences
Research Council