# Guide to Monitoring Impact of Storm Overflow

## INTRODUCTION TO THE UK ENVIRONMENT ACT 2021

**The Environment Act 21 became law in November 2021 and sets out ambitious targets for the protection of our rivers, estuaries, and coastal zones. Part 5 Section 82 requires water utilities to continuously monitoring water quality upstream and downstream of all storm overflow and sewage disposal works, which discharge into a water course.**

Water quality monitoring requires the measurement of Dissolved Oxygen, Temperature, pH, Turbidity, Ammonia, and anything else specified in regulations made by the Secretary of State. With 20,000+ Combined Sewer Overflows, plus over 7,000 sewage treatment works in England & Wales, this Act creates a significant challenge to the industry in terms of installation, monitoring and continuous maintenance.


Figure 1. River, England, UK

### Current state

Combined Sewer Overflows (CSO) are designed to collect both wastewater and stormwater through a single pipe, carrying the combined flow to a treatment plant. Combined sewers are equipped with a relief flow route, so that during surge events pipes and treatment plants are not overwhelmed, resulting in potential flooding of homes and commercial premises. To better understand the impact of these discharges, the Environment Agency introduced a programme requiring water companies to install monitors on the vast majority of storm overflows.

At the end of 2022, 90%+ of all storm overflows were fitted with Event Duration Monitors (EDM), which are a consistent way of monitoring the frequency and duration of discharges. Over 12,000 EDMs have been installed in England & Wales providing data to the Environment Agency as part of the Water Industry National Environment Programme (WINEP). Although this data is valuable in understanding which sites overflow, they cannot measure the water quality impact on the receiving waters.

### Challenges of large-scale water quality monitoring programmes

When putting together a large-scale monitoring programme, it is typical to focus on which sites to monitor, what parameters need to be measured, the required accuracy, preferred suppliers with a proven track record, and price. Whilst these are important factors, they do not represent some of the major risks and costs required to run a successful monitoring programme.

## Priority sites

A programme of this scale will take some years to install, so priority sites will need to be identified and communicated with suppliers. EDM data collected over the years provides a good basis for risk-based monitoring as well as the use of water bodies as bathing waters.

## Clustering and exceptions

There are many examples of multiple overflows in close proximity to each other. This could lead to excessive numbers of monitors, increasing both costs and maintenance. Due to this reason, clustering is expected to be used as a monitoring strategy. DEFRA guidance on clustering (distance between storm overflows) and exceptions will determine the total number of monitors required to be installed.

## Land access

By far the biggest challenge of Section 82 is land access. The majority of storm overflow sites sit on private land. Water companies will be required to engage with landowners for, not only permission to install instrumentation, but also the need for routine maintenance and calibration visits. It is expected that this challenge will have a significant knock on cost.

## Installation and skillsets

Understanding who will deliver the installation, including any civil works, will be critical to any project. Water companies will need to agree Scope of Works and Responsibility Matrix prior to entering into a contract with a supplier. It will be a challenge to the industry to hire and train people to install and roll out this program so early engagement is a must.

## Health and safety

With an increase in the number of installed monitors, it is important to consider the installation design to remove the need for the user to enter the water during calibration or maintenance. Due to this requirement, it is recommended to use either multiparameter sondes installed in a standpipe or use of a pumped kiosk system.

## Power

Many of the proposed sites will be in remote applications with no power. Strategies such as Solar or Fuel Cells will need to be considered depending on type of system and requirements.

## Choosing the right site

The aim of Section 82 is to monitor the impact on the receiving waters, not the discharge itself. Therefore, careful consideration is needed for choosing the sensor location. Issues include flow, mixing, aeration, siltation, eddies, vegetation, high velocities, storm debris, animal activities, human activities, floodplains, unstable banks, site access and land permissions.

## Theft and vadalism

With monitors being installed in both rural and urban environments, specific attention needs to be made to potential impacts of theft or

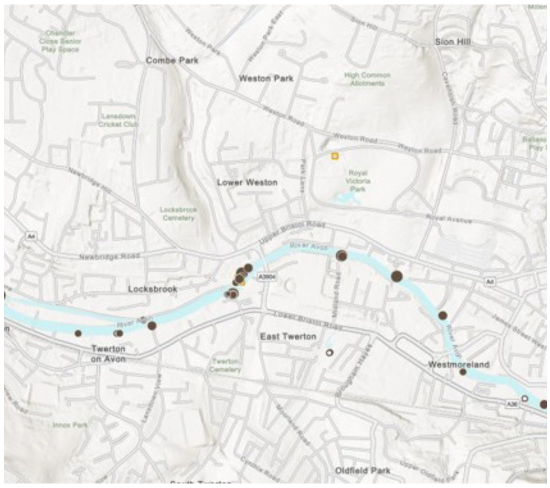


Figure 2. Example of clustering: Rivers Trust map

Figure 3. Solar Water Quality Monitoring Station

Figure 4. Water Quality Kiosks

vandalism. Site surveys are a must to understand risks and design solutions for these sites.

**Parameters to measure**

Section 82 specifies the mandatory parameters of Temperature, Dissolved Oxygen, Turbidity, Ammonia, pH, plus any other parameters specified in regulations, made by the Secretary of State. Water quality parameters can be placed into three basic categories for continuous field measurements:

- **Lab replacement** – Real-time measurement in the field, directly comparable to laboratory reading. Examples include Temperature, Conductivity, pH, Turbidity, Dissolved Oxygen.
- **Complimentary** – Real-time trends complimenting, but not replacing the laboratory measurement. Examples include Chlorophyll, Blue-Green Algae, Tryptophan, Dissolved Organics.
- **Site specific** – Derived measurements requiring multiple site specific grab samples and laboratory correlation. Examples include BOD, COD, E. coli, Total Suspended Solids.

Section 82 is based on the use of laboratory replacement parameters to ensure that the collected data is defendable using repeatable and traceable methodologies.

**Calibration**

With the highest ongoing costs being calibration, careful consideration is needed when implementing a large-scale monitoring programme. Whilst most sensors can be calibrated in both the laboratory and the field, errors can occur due to poor sensor cleaning and contamination of solutions. Due to these reasons, it is highly recommended to utilise central calibration in the laboratory and simple field swap outs of units or sensors.

The use of digital smart sensors, which hold their meta data, including when they were calibrated, by whom and their results, will ensure full traceability and easier management of a sonde fleet. With the British weather being a factor, other features such as wet swappable sensors or ability to remove the sensors for cleaning is desirable.

**Data as a service**

Xylem operates a flexible Data as a Service (DaaS) program, which moves the responsibility of the data, telemetry, calibration and swap out of sondes to the manufacturer. DaaS comes in many variations, from in-house calibration services of water company owned instrumentation, all the way up to paying for the data only. This option should be a consideration in any monitoring programme.

**Accuracy**

It is important to get a real understanding of true field performance when choosing your supply partners. Stated accuracies can vary significantly from manufacturer to manufacturer, with some stating accuracy in laboratory buffers and others based on field measurements. It is highly recommended to set-up a small-scale

Figure 5. YSI EXO Multiparameter Sonde

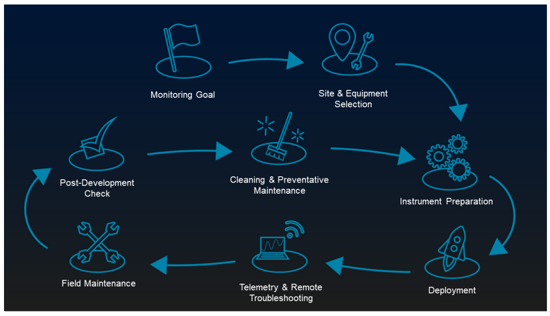


Figure 6. The true cost of data

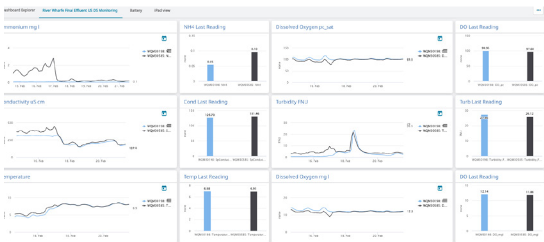

Figure 7. Xylem HydroSphere upstream/downstream dashboard

pilot study to assess true field performance needed for robust and defendable data.

**Delivery times**
Rarely does the industry see demand for a large number of instruments from multiple water utilities at the same time. As such, deliveries will be one of the largest challenges for this project. The use of frameworks with specific roll out programmes is highly recommended, allowing manufacturers to plan in advance, based on the agreed delivery programme.

**Fouling**
All sensors are subject to biofouling, which will impact data integrity. The use of multiparameter sondes which utilise a high-torque central wiper system and sapphire glass surfaces, provide the best in class anti-fouling in low power applications. Poor or non-existent anti-fouling techniques will risk data integrity and result in increased field visits, especially in summer months.

**Quality of data**
The best sensors with poor installation or maintenance will provide bad data. A robust maintenance program is required to ensure the best possible data. This is typically every 2 – 3 months.

**Sensor drift**
Some manufacturers may exaggerate the stability of their sensors and claim extended times between calibrations. Whilst positive on paper, this can lead to a poor calibration regime and sensor drift. All sensor technology is only as good as its weakest parameter. In the case of the Environment Act, this sensor is Ammonium and will require calibration every 2 months. However, when correctly installed and maintained, these sensors can provide excellent low-end sensitivity as shown in Figure 9.

**Cyber security**
Product cybersecurity has become a market imperative to gain the trust of our customers. Xylem recognises this imperative and seeks to grow the faith and trust our customers have in our products and services. Our customers are clearly expressing their concerns regarding the safety of an ever increasingly cross-connected and cloud-based solution set. In partnership with client IT departments, the Xylem cybersecurity team can help to push the boundaries of analytical and performance management capability while adhering to the most rigorous safety standards.

**Conclusion**
Whilst the scale of the challenge created by Section 82 is significant, we should take comfort that the technology to deliver on this challenge exists. Sonde technology has developed over the years to ensure long term reliable data, which is field proven. As such, this is a cost and logistical challenge rather than a purely technical one but requires collaboration. Large scale, robust water quality data, will allow us to digitise our river catchments, understanding and reacting to events to provide a cleaner and heathier environment for all.

Figure 8. Effective anti-fouling using wiper

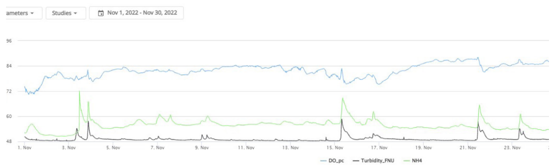


Figure 9. Example of ammonium low end sensitivity