EIP Water – Action Group (AG100)
Innovative monitoring technologies and EU Water legislation
A white paper

Version: July 2015

1 - Introduction

This white paper addresses the role and position of water quality monitoring innovations within EU water legislation. When developing or revising EU water legislation, it is inevitable that the latest innovative monitoring technologies are not immediately included in the new legislation. This white paper describes potential solutions in order to stop innovations being (unnecessarily) blocked by legislation while at the same ensuring that novel monitoring technologies meet the necessary requirements before being applied.

1.1 - Objective of "*Real Time Water Quality Monitoring*"[1] Action Group (AG100) under EIP-Water

The main goal of the Real Time Water Quality Monitoring (RTWQM) Action Group is to foster solutions to water challenges based on online water quality monitoring technologies and affordable monitoring strategies. The RTWQM concept includes autonomous sensors and analysers which measure physical, chemical, radioactive or biological water quality parameters in (near) real-time with minimal maintenance requirements and waste generation. In addition, the RTWQM concept also covers the retrieval, transmission, processing and validation of raw data, in order to convert these into useful information.

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2 - The Challenge

Keeping EU water legislation up-to-date and in line with technological developments is a major challenge. In reality, legislation is always somewhat behind on the latest (technological) developments, since the process needed to develop or revise legislation can be lengthy and labour-intensive. As a result, the new or revised (water) legislation is already more or less out of date by the time it enters into force. In the meantime, research and development of e.g. water quality monitoring technologies have continued and led to new monitoring technologies becoming commercially available. These technologies are not covered or addressed by legislation, and as a result, some novel monitoring methods cannot be deployed for e.g. compliance monitoring, although they may offer significant benefits. Nevertheless, new (non-conventional) monitoring tools

[1] http://www.eip-water.eu/RTWQM

can be used as standard routine methods, and their output periodically checked against officially accepted methods for compliance.

The EU Drinking Water Directive (DWD; 98/83/EC) offers the possibility to use water quality monitoring methods not described under the current legislation, provided the method is proven to be equivalent to accepted methods. This is an important requirement for new monitoring methods, since public health needs to be guaranteed. Therefore, the DWD clearly states that "methods used to analyse the quality of water intended for human consumption should be such as to ensure that the results obtained are reliable and comparable". In practice this means that the methods used are to be accredited according to (international) standards such as ISO 17025.

Annex III of the DWD indicates a number of specified methods for mainly microbiological parameters, but states that Member States may use alternative methods, providing the provisions of Article 7(5) are met:
"7.5.b Methods other than those specified in Annex III, Part 1, may be used, providing it can be demonstrated that the results obtained are at least as reliable as those produced by the methods specified.
7.5.c For those parameters listed in Annex III, Parts 2 and 3, any method of analysis may be used provided that it meets the requirements set out therein."

In the draft revision of Annex III of the Directive[2] a reference is made to Commission Directive 2009/90/EC laying down technical specifications for chemical analysis and monitoring of water status under the EU Water Framework Directive (2000/60/EC), thus aiming at harmonisation across different water directives. This illustrates that other water directives also struggle with the identification of suitable monitoring methods to ensure public or ecological health related to water quality.

The main questions to be answered in this white paper are:
1. How can innovative (online) monitoring technologies contribute to the successful implementation of water-related directives such as the DWD?
2. How can European water legislation be formulated in such a way that it does not hamper or block the use of innovative (online) monitoring technologies which can contribute significantly to achieving the directives' goals?

The main focus of this document is on the DWD, although the general concept may very well be applicable to other EU water directives. An example of this is given in Section 3.4.

3 - Proposed solution

The proposed solution to these questions consists of various building blocks which are already available to the European Commission and the Member States.

3.1 - Implementation of Water Safety Plans

The Water Safety Plan (WSP) approach such as envisaged in the DWD after its revision is a powerful tool to collect as much water quality data as necessary to guarantee safe drinking water, at minimum effort and costs. A risk assessment indicates which parameters are critical, and monitoring programmes are devised accordingly. Regular checks are built in to ensure the list of parameters to

[2] http://ec.europa.eu/environment/water/water-drink/pdf/DWD_Annex%20III_draft_consultation_final.pdf

be monitored is still correct. Innovative (online) monitoring technologies can play an important role in assessing both the risks to water quality and the effects of mitigation measures.

3.2 - The Dual Reporting System for water quality information

In 2013, a report on the future of reporting under the DWD was prepared as part of a Framework Service Contract for Support to the Implementation of the Water Industry Directives (contract no. ENV.D.2/FRA/2012/0013)[3]. This report suggests a dual reporting system (DRS) for drinking water quality information in line with the Water Safety Plan approach, as illustrated in Figure 3.1.

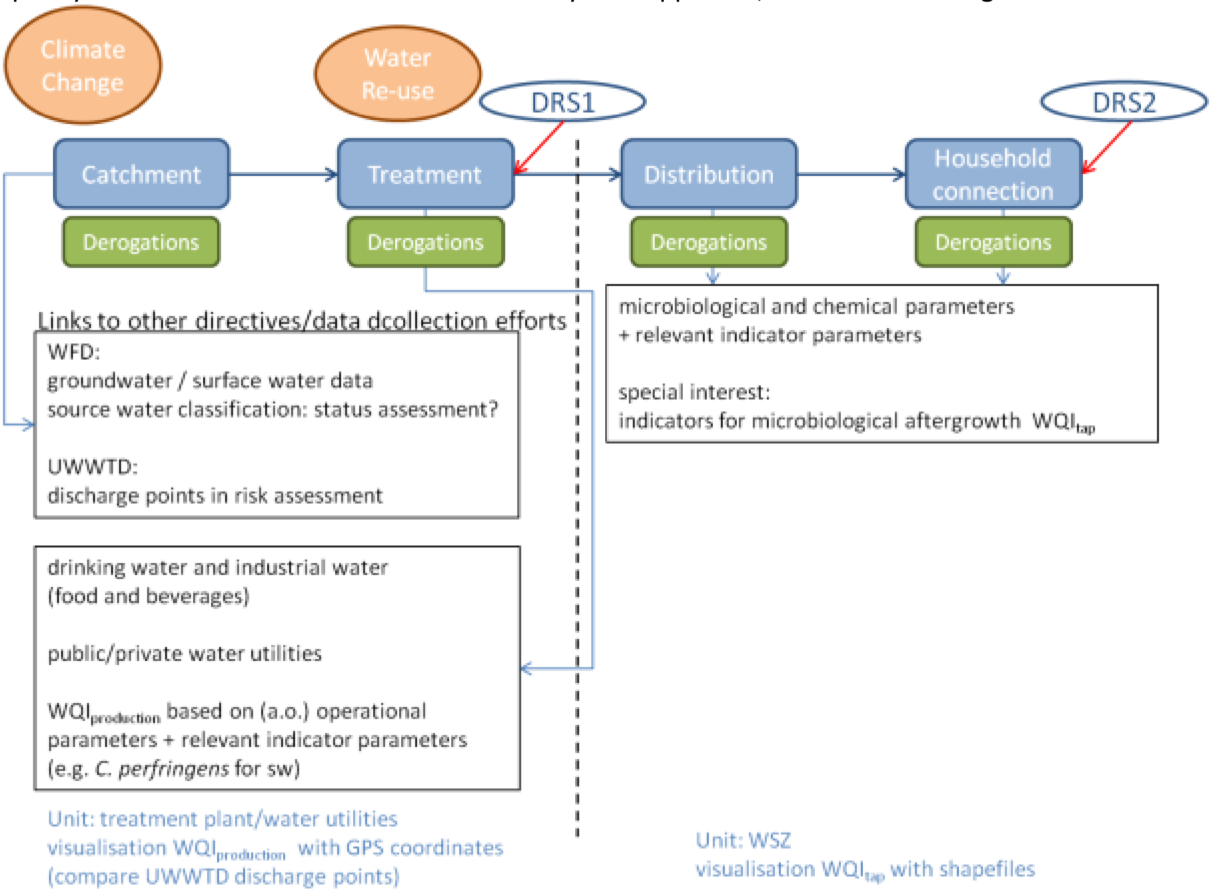

Figure 3.1 Schematic structure of the suggested dual reporting system.

The dual reporting system splits the drinking water information into two major groups, following the risk-based approach:

1. Information about the catchment (drinking water sources) and the treatment system;
2. Information about the distribution system and household connections.

This approach is intended to serve 2 major goals:

- assess the effectiveness of processes and controls to guarantee water safety throughout the water supply system applying the risk-based approach set out by the World Health Organisation.
- provide regular information on the quality of the water supplied for human consumption, in order to determine whether or not water intended for human consumption complies with the parametric values laid down in the DWD.

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[3] Carpentier *et al.* (2013). Development of a Concept for the Future of Reporting under the Drinking Water Directive. Concept Paper. Presented to the Commission and the Drinking Water Committee on 10 September 2013.

In the DRS, drinking water quality is evaluated separately, after production (at the point where it leaves the water utility) and at the consumer's tap: the former results in information relevant to water utilities in relation to the risk-based approach, whereas the latter allows for compliance checking in accordance with the DWD requirements.

Figure 3.1 shows that the WSP-approach can link many relevant pieces of EU water legislation, taking the DWD as a basis. Drinking water resources are to be protected with the help of e.g. the Water Framework Directive (WFD; 200/60/EC), the Nitrates Directive (91/676/EEC), the Urban Wastewater Treatment Directive (UWWTD; 91/271/EEC) or even marine directives where it concerns drinking water made from seawater through desalination processes. Important developments such as climate change and technologies to improve water re-use can be easily included in this set-up. In the second part of the DRS, important issues can be addressed such as the harmonisation of regulations on materials in contact with drinking water.

Online monitoring can play an important role in the WSP approach by enabling utilities to monitor a wide variety of relevant drinking water quality parameters at various points in the entire process of abstraction, treatment and distribution of water. This type of monitoring mainly serves the utilities themselves, as it helps to gain insight in water quality developments and potential risks. An example of this is online alpha or beta radiation monitoring for early detection of (intentional) water contamination at any point in the process from catchment to distribution. The current laboratory methods do not allow for such detection.

For compliance monitoring, specific parameters need to be analysed for which often only laboratory methods exist. Online monitoring technologies currently play a limited role here, although future developments may lead to technologies which can adequately and cost-effectively monitor these parameters. Additionally, supporting parameters which indicate (sudden) changes in water quality, such as pH, conductivity, dissolved oxygen or so-called fingerprinting methods, can play an important role in e.g. the distribution network or surface water intake points, in order to receive an initial indication that public health may be at risk if no action is taken. Monitoring activities can thus be classified according to their purpose and location in the drinking water production and distribution process, as is shown in Table 3.1.

In order to be effective, all monitoring technologies should meet certain basic standards of reliability, precision and repeatability. However, the exact requirements may differ according to the purpose of monitoring. For example, nitrate monitoring in the catchment is important in order to determine the required treatment capabilities, but the precision of these measurements does not have to be as high as for nitrate monitoring at the tap, nor does the detection limit have to be as low. It is therefore suggested to set requirements for monitoring technologies according to their location and purpose. This will create space for innovative monitoring technologies to be applied when and where deemed appropriate, without compromising the directive's aim to guarantee the use of suitable methods for compliance checking in order to protect public health.

Table 3.1 Location and purpose of different types of monitoring

Location	Purpose	Examples of parameters/technologies
Catchment	WSP monitoring	Risk assessment on the basis of upstream industrial/agricultural activities or intentional contamination
	Early warning	Online biomonitoring for the detection of pesticides; online alpha or beta radiation detection
Treatment	WSP monitoring	Risk assessment of treatment process
	Process optimisation	Colour, DOC
Distribution	WSP monitoring	Microbiological aftergrowth in network; risk assessment of intentional contamination
	Early warning	Refractive index, conductivity, pH; online alpha or beta radiation detection
Tap	Compliance monitoring	*E. coli*, pesticides, nitrate

3.3 - EU Environmental Technology Verification Programme

The "EU Environmental Technology Verification (ETV)" pilot programme[4], coordinated by the European Commission's DG Environment, offers an independent procedure to assess the performance of new, potentially breakthrough technologies. It provides a third-party verification of innovative environmental technologies. By signing up to the programme, sensor manufacturers receive the opportunity to showcase the added value of their technology through independent assessment of its performance, which involves reliable and tailored testing procedures. One of the ETV's main focus areas is water treatment and monitoring.

Besides providing scientific and technical support to the initiative, in particular by coordinating and chairing the Technical Working Groups which ensure the harmonisation of ETV practices across the different verification bodies of the ETV pilot programme, the Joint Research Centre (JRC) manages the central registry of verification statements. The Statements of Verification of the completed verifications, including additional verification documentation, are publicly available and can be consulted on the central registry. The JRC also represents the European Commission as an observer in the discussions of the upcoming international standard (ISO) on ETV.

The ETV programme seems to be a suitable tool for determining the validity of novel monitoring technologies. With the help of the ETV programme, sufficiently valid monitoring technologies can easily be distinguished from unsuitable or untested ones. Its European character ensures that novel monitoring technologies are tested and approved according to harmonised standards in order to avoid differences between Member States. Additionally, it is not necessary for technology providers to prove their technology separately in each individual Member State. Since the programme has already been established (although it is currently only a pilot programme), it is not necessary to invent new structures or procedures. Harmonisation with specific requirements following from monitoring requirements under the DWD is therefore recommended, so that the ETV certification programme can support the introduction of novel water quality monitoring technologies without the need for descriptions of methods in each individual water directive.

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[4] http://iet.jrc.ec.europa.eu/etv/

Thus, European water legislation can be formulated in such a way that innovative monitoring technologies can be applied as soon as they become commercially available, provided these technologies meet certain general requirements with regard to the location and purpose of the monitoring effort, as certified through the ETV programme.

3.4 - Future direction

Following the WSP approach, different requirements for ETV certification can be set for monitoring technologies according to their purpose and location in the drinking water production process. Once a certificate has been issued under the ETV, Member States are assured that the technology used is fit for purpose according to the requirements set out in the DWD or other water directives – as guaranteed by the EU's own certification programme. For methods already used and approved under the current DWD, a transitional arrangement can be organised.

The overall approach to water quality monitoring, supported by the WSP approach, the dual reporting system and the ETV programme described above, can potentially be used as a blueprint for other water directives dealing with e.g. wastewater re-use. Application of the DRS to treated wastewater reuse could result in a separation of the monitoring and reporting of: the sewage network, the treatment plant and the effluent discharge. The first section is critical to define the quality and quantity of sewage reaching the plant, causes of variations (illegal dumping, etc.), and to allow WWTP operation consistent with actual influent and desired effluent water quality. Monitoring at the treatment plant is focused on process optimisation, whereas effluent monitoring provides insight in potential risks for the receiving water.

4 - Conclusions

The initial questions raised in Section 1 were:

1. How can innovative (online) monitoring technologies contribute to the implementation of water-related directives such as the DWD?
2. How can European water legislation be formulated in such a way that it does not hamper or block the use of innovative (online) monitoring technologies which can contribute significantly to achieving the directives' goals?

The Water Safety Plan approach, a corresponding dual reporting system and the European ETV programme together propose a solution to these questions of monitoring under the Drinking Water Directive. The WSP approach combined with the DRS allow for a separation of monitoring activities according to their purpose and location in the drinking water production and distribution process. This determines the specific requirements which the monitoring technologies have to meet, be it a laboratory method or an online sensor. The ETV programme provides an unbiased and independent performance assessment which allows novel monitoring technologies to prove their validity. This opens up the DWD for scientifically validated technologies, either lab-based or online, and eliminates the need to address requirements for monitoring technologies in the directive itself, with the risk of being outdated shortly after each revision.

In order to achieve this, it will be necessary to come to an agreement on the exact requirements for monitoring methods under the DWD without endorsing particular methods – this is not an easy task. But once this has been accomplished, the introduction of innovative technologies will no longer be blocked by provisions in the directive if there is no scientific ground for excluding them. This will further stimulate the development of novel monitoring technologies which support the protection of public health and overall drinking water quality.